Sub urban Metabolism

in the Greater Toronto Area

P5 Report

Author: Michelle Blom

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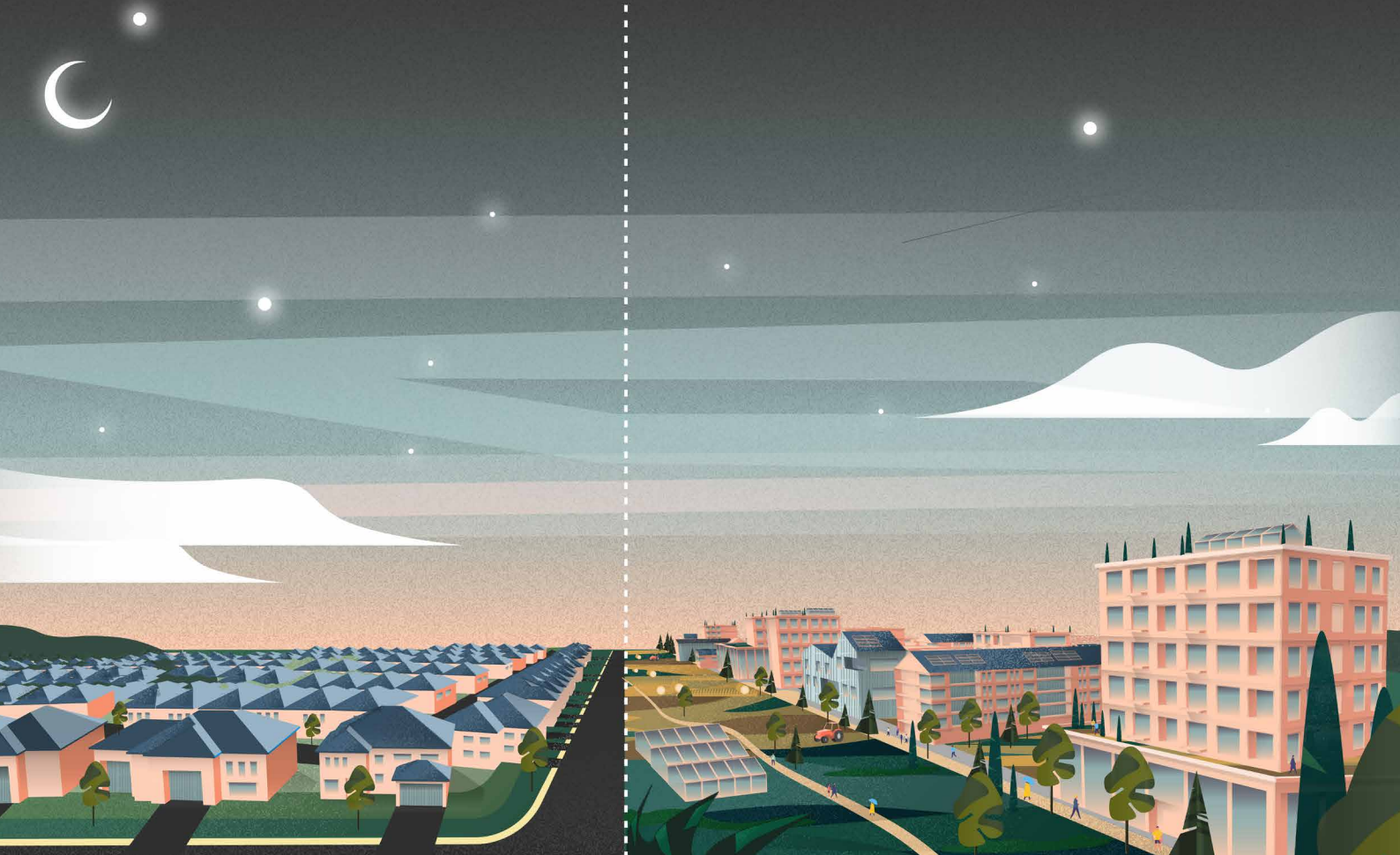
First Mentor: Alexander Wandl
Second Mentor: Dominic Stead



TU Delft

*Sub*urban Metabolism

Michelle Blom
4749073
July 3, 2019
Delft University of Technology
Faculty of Architecture and the Built Environment
MSc Urbanism

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1.0 Introduction + Context

1.1 Suburban Metabolism in the GTA

The issue of suburban sprawl in the Greater Toronto and Hamilton Area (GTA) has been known to increase the pressures of land consumption, infrastructure development, resource consumption, and population growth over the past 50 years. The same can be said for many peripheral regions of Canada's urban areas. In 2011, two-thirds of the population of Canada lived in some form of suburban neighbourhood, and for the GTA a larger percentage of 86% (Gordon, 2013). Though this growth continues, the vast expansions of automobile-dependent neighbourhoods have shown to have prolonged effects on resource consumption, carbon emissions, ecosystem devastation, declining health rates, social segregation, and the destruction of available agricultural land in Ontario.

Yet these problems are not new. Neither are the solutions. Suburbs have been the centre of angst for many contemporary urban planners in North America for over thirty years (Grant, 2009). This has been the motivation for theories such as New Urbanism, Smart Growth, and Sustainable Development, three ideologies which have already been integrated into Provincial and Municipal Policies in Ontario. Most of which are focused on general themes of traditional aesthetics and densities of suburban development and most of which have failed to change the form of suburban development in Ontario.

It is well known that massive shifts of planetary systems and urbanized population growth will require more efficient and resilient uses of land and resources. The future well-being of both settlements and ecosystems rely on the management of these assets. This realization is yet to be seen in the current development of suburban areas in the GTA. As the expansion of the Toronto periphery continues, the region is responsible for providing more infrastructure, amenities, and materials on an increasing amount of land. This inefficient system of human settlement has been based on a period of resource abundance. Now, this structure has the ability to intensify the effects of climate change on residents by the inability for municipalities to provide services in times of crisis or reform. The intent of the thesis is to provide insights and solutions which may alleviate the pressures of future systems, and create a more sustainable framework for growth considering the existing consumption of resources. Ideally, the study will have applicable solutions for other North American cities, facing similar challenges with suburban sprawl.

1.2 Motivation

I began my Master's degree at TU Delft interested in the broad topics of sustainability and resiliency. This was not without skepticism. After three years of professional experience in urban planning and design, it was clear that sustainability and resiliency have become broad terms, easily incorporated into various policy documents. Yet, the inclusion of sustainable values in policy has seemed to have little to no effect on development practice in Canada. Through my Master's degree, I intended to research something more specific and concrete for possible solutions within the planning and design realm.

Through my first year at TU Delft, I began to study and review Urban Metabolism, a field which calls to my knowledge and interest in spatial data, GIS software, resource management, regional research, and environmental technology. More importantly, it presented an opportunity to create a deeper understanding of sustainability through the analysis of urban ecosystems with quantifiable evidence of resource balances. Systems-thinking also provides a framework to identify the relationships between these balances and socio-economic conditions.

I am from Toronto, but I have not conducted any research on the city. Through this project I intend to take a context I know well and challenge my assumptions throughout the process, using the knowledge I have gained from Urbanism in the Netherlands and at TU Delft.

Figure 1 Toronto Aerial, June 2008. Source: NextCity.org

Figure 2 National Context. *Source: Scholars GeoPortal Data & Esri Basemap Images*

1.3 Project Context
Greater Toronto, Ontario, Canada

The Greater Toronto Area is located in the province of Ontario within middle-eastern Canada. Ontario is Canada's most populous province with a population of 14.19 million residents (Statistics Canada, 2016). Ontario sits between the province of Manitoba and the province of Quebec. Along with the majority of Canadian provinces, Ontario is mostly populated in the southern regions. Southern Ontario contains six major cities, including Sudbury, Hamilton, Niagara Falls, Kingston, and Canada's capital city of Ottawa. Most of which sit in close proximity to the Great Lakes. Greater Toronto, is located directly on Lake Ontario. Greater Toronto is the most populous region in Canada including 6.4 million inhabitants, becoming 42% of the province's population.

The GTA can be included in other administrative regional boundaries in several policy documents and studies. These boundaries include the Greater Toronto Area and Hamilton (GTAH), and can also be referred to as part of the Greater Golden Horseshoe (GGH) which includes an even broader area reaching as far as the Niagara Falls region. In terms of this report, Greater Toronto will be referred to as the GTA, perhaps opening to the broader region (beyond political boundaries) throughout the process. As seen in Figure 3, 'Urban Toronto' is a comparably moderately small portion of the GTA boundary with 2.7 million inhabitants. The Greater Toronto boundary includes this boundary of the City of Toronto, along with the four regional municipalities which surround it. These regions include: Durham, Halton, Peel, and York Regions. All together, these regions account for 25 municipalities.

It is important to note that Toronto is currently upon the unceded territory of the Huron-Wendat Nation, Metis Nation of Ontario, Mississaugas of the New Credit First Nation, Mississaugas of Scugog Island First Nation and Six Nations of the Grand River as the traditional inhabitants of the lands of what has been settled as Greater Toronto (Traditional Territory Acknowledgements in Ontario, 2017 & https://native-land.ca/).

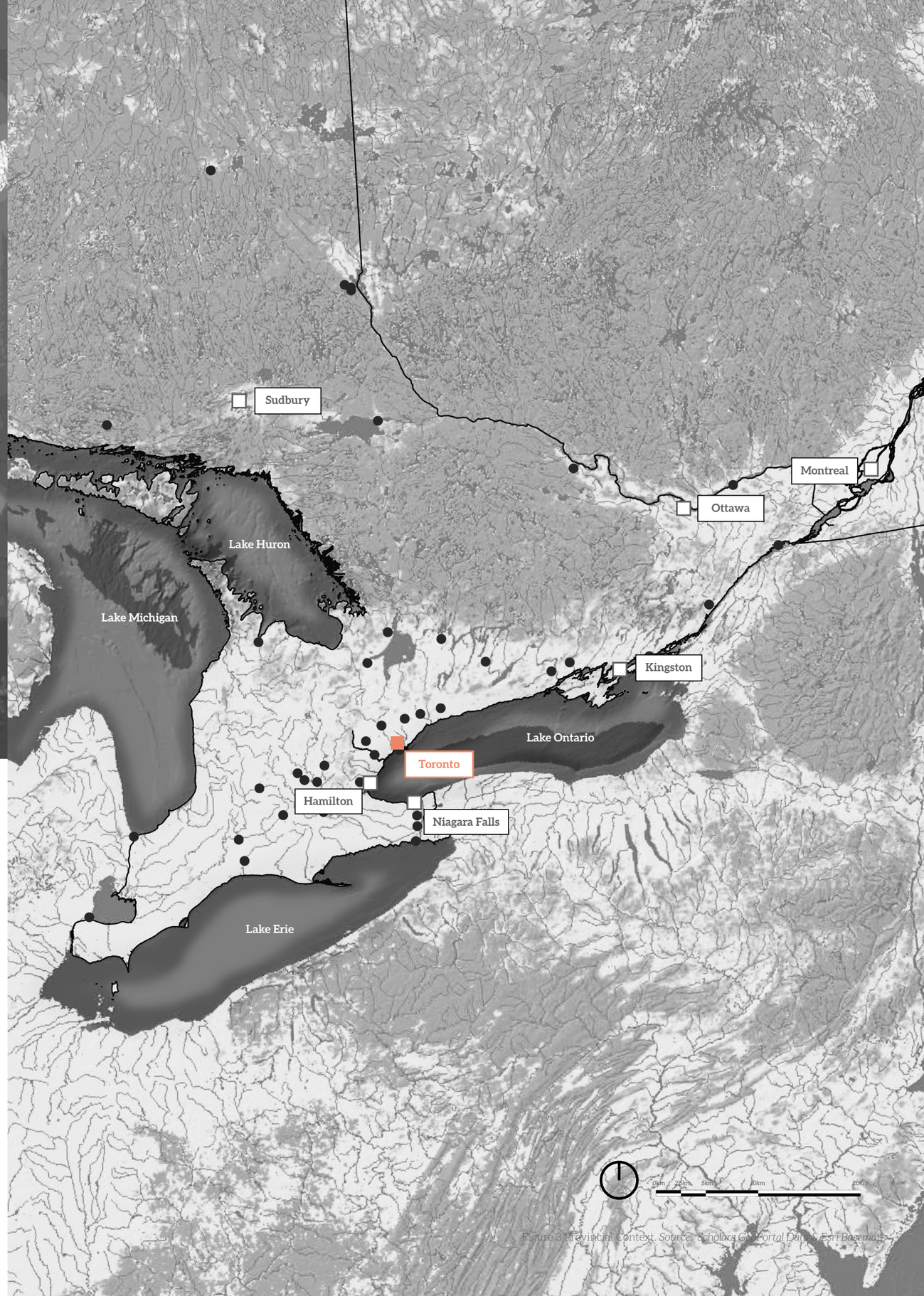
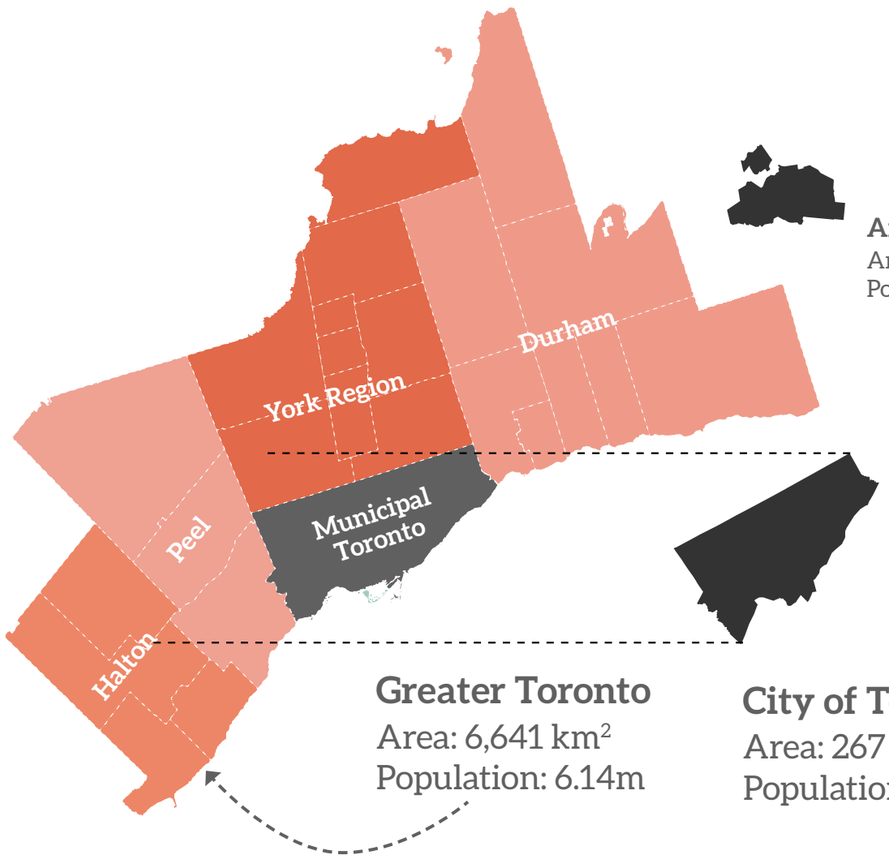


Figure 3 Provincial Context. *Source: Scholars GeoPortal Data & Esri Basemap Images*

Organization & Boundaries



Amsterdam
Area: 197 km²
Population: 0.821m

Greater Toronto
Area: 6,641 km²
Population: 6.14m

City of Toronto
Area: 267 km²
Population: 2.732m

55% of the population of the GTA currently lives outside the city of Toronto in 4 outer regions

Figure 4 Greater Toronto Regions and Residents. *Source: Statistics Canada CMA Shapefile & Esri Basemap Images*

Figure 5 Toronto Structure *Source: Scholars GeoPortal Data & Esri Basemap Images*

Greater Toronto Structure

The GTA is surrounded by the Greenbelt along the periphery of the built area. In order to connect the regions within the GTA, the area has a network of expressways for vehicular use. The primary expressways move north-south and east west, but do not intersect the city centre of Toronto due to community efforts to stagnate the demolishing of housing to make room for infrastructure. On the other hand, the Go Train Lines stem from the city's downtown into the regions of the GTA. Though the network reached a far distance, the Go Train Lines were placed after much of the suburban development in the region was already constructed, making the stations servicing challenging to access without a vehicle. As seen in blue, the GTA has major river corridor connections from the Greenbelt to Lake Ontario. Development generally forms itself around these corridors due to Provincial Flooding Regulation.

2.0 Problem Field + Analysis

Figure 6 Suburban Growth Article Titles. *Source: Toronto Star & Globe and Mail*

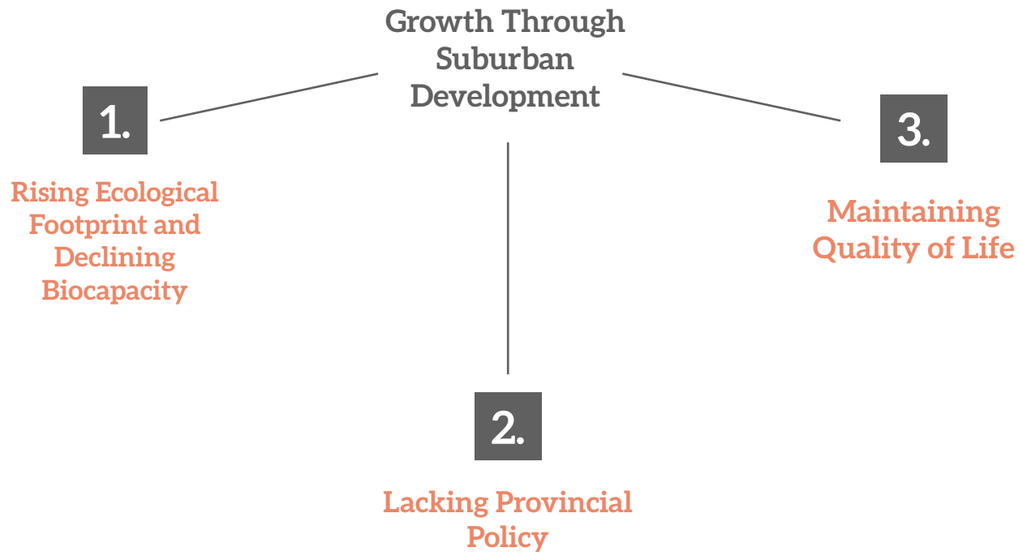
2.1 Problem Field Introduction

The future of the GTA

The fact that Ontario's population is at 14.16 million and rising creates a level of concern when reviewing the practice of consumption and production of natural resources in the province. The current and most consistent data available on the subject includes the average ecological footprint of individuals in the province. Ecological Footprint quantifies the demand that human consumption and waste generation places on our biosphere by measuring the area of biologically productive land and water that is needed to produce all the resources humans consume (Global Footprint Network, 2010). The ecological footprint in the province is 8.40 global hectares, a high average when comparing to the rest of Canada (7.1 gha), especially when the country already has the 8th highest ecological footprint in the world (Global Footprint Network, 2010). What increases unease, is that the province's biocapacity (maximum productivity of resources in the landscape) is 6.1 gha, creating a 2.3 gha gap between the demand and supply of resources. Such a gap can be considered as a feat given the sheer amount of resource dense land in the area (Global Footprint Network, 2010). This gap is projected to increase, as a rise in population will inherently increase the total ecological footprint, and decrease the biocapacity through urban expansion. The bulk of the projected growth in Ontario will take place where 50% of its population already resides: the Greater Toronto Region (GTA) (Statistics Canada, 2011). It is Canada's most populous metropolitan area at 6.418 million inhabitants, and is projected to grow to 10.130 million in 2041 (Province of Ontario, 2017). This growth will not only increase the ecological footprint consumption of Ontario, but also expand the region's built-up area, interfering with the bioproductive landscape. In addition, the GTA falls within the southern Mixedwood Plains Ecozone, known as the most bioproductive landscape for agriculture in Ontario, with almost all of the agricultural land and 76% of built up land (Province of Ontario, 2010).

Considering the GTA accounts for half of the current and future population of Ontario and contains the crucial agricultural biocapacity zones, the GTA must manage consumption levels and reduce the overall consumption of resources and land which is threatening its biocapacity. Considering the global uncertainties in a resource scarce future, it is critical to achieve a sustainable balance between supply and demand, increasing the resiliency of regions.

The challenge with suburban growth in the GTA is three-fold



When controlling the growth of the built area if the GTA, it is essential to address the biggest target of population growth: suburban municipalities. On one hand, greenfield suburban development is responsible for the land-use changes which reduce agricultural and natural regions, on the other, single-family, and semi-detached homes are known to have the highest ecological footprints within Canada (Grunewald & Ouellet-plamondon, 2016).

However, this problem is not new in the realm of planning in Ontario. The provincial government has been attempting to avoid sprawl and instigate central growth since 2006. While the Provincial government of Ontario has established the *Places to Grow* legislation for the GTA, the region has yet to critically advance its development practice to increase sustainability measures in suburban regions. The provincial mandates which call for density and Transit-Oriented Development has proven to not be enough to change processes of consumption, travel patterns or housing patterns in the region. Instead, most development practices have favored detached, low-density, and car oriented, greenfield developments. Thus far, development has favored the lifestyle choices assumed to be desirable from home buyers and the real estate market.

Therefore the problem is threefold, in order to achieve sustainable development with upcoming suburban growth, actors must deal with rising ecological footprints with declining biocapacity, a lacking provincial policy for controlled suburban development, and the demanding consumer preference for low density housing types in the GTA. Therefore, this project is intended to develop a regional growth vision for the Greater Toronto Area which will identify solutions beyond the traditional intensification anywhere approach.

2.2 Suburban Growth

Suburban, not Sprawl?

Suburban living has been embedded into the city fabric and consumer preference of the GTA since the ending of WWII. The desire for home ownership, the availability of affordable land, the possibility for capital, and the decentralization of industry, created the shift towards suburban areas along the fringes of the urban Toronto boundary (Sorensen, 2011). Some even argue that the post-war suburban growth was moderately successful in comparison to American cities' 'unplanned' sprawl. In fact, Toronto had moderated a regional planning department for development in the 1950s and 60s and the result, was a tightly linked municipal investment infrastructure with connecting sewer and water supply systems (Hess et al., 2015). The development controls regulated by the planning body monitored the infrastructure and obtained payments from developers as well as assured parks were included in development blocks (Hess et al., 2015). The metro regional plans set out to created a moderately dense regional structure with controlled boundaries and planned cores with amenities, commercial, cultural and institutional uses. This included a mix of housing types and major public transport (Hess et al., 2015). Nonetheless, the metro regional planning department had diminished by the late 1960s due to political strides and development control fell into the hands of local municipalities.

Years later, when the population of the Toronto Region grew to over 5 million, the current, more criticized suburban development has taken place. Patterns have drastically changed (Hess et al., 2015). The actual development plots and the size of mono-functional areas have increased, land uses have also become even less mixed, and the structure of street design has it nearly impossible to adapt to new uses other than single-use residential (Hess et al., 2015). In Figure 7, one can see the changes of these exemplary patterns from the 1971 suburb, to 2011, which is more representative of the densities which are being constructed in modern suburban development. Contemporary suburban development has seen a large change in zoning and building code regulations, including smaller rear and internal yard setbacks which allow for a higher density along suburban roads. These densities have been a result of policy and zoning changes, and a continuous demand for single family housing. As suburban development continues to grow, single-family and semi-detached homes, not compact communities, will likely be the result.

So far, the GTA suburbs reach as far as Newmarket, Ontario, approximately 40 kilometers from Toronto's downtown. The current rate of suburban development is a significant call for change, as the population of the GTA continues to increase to 10.13 million by 2041.

Figure 8 Source: Growth Plan for the Greater Golden Horseshoe, 2017

50 Years of Growth

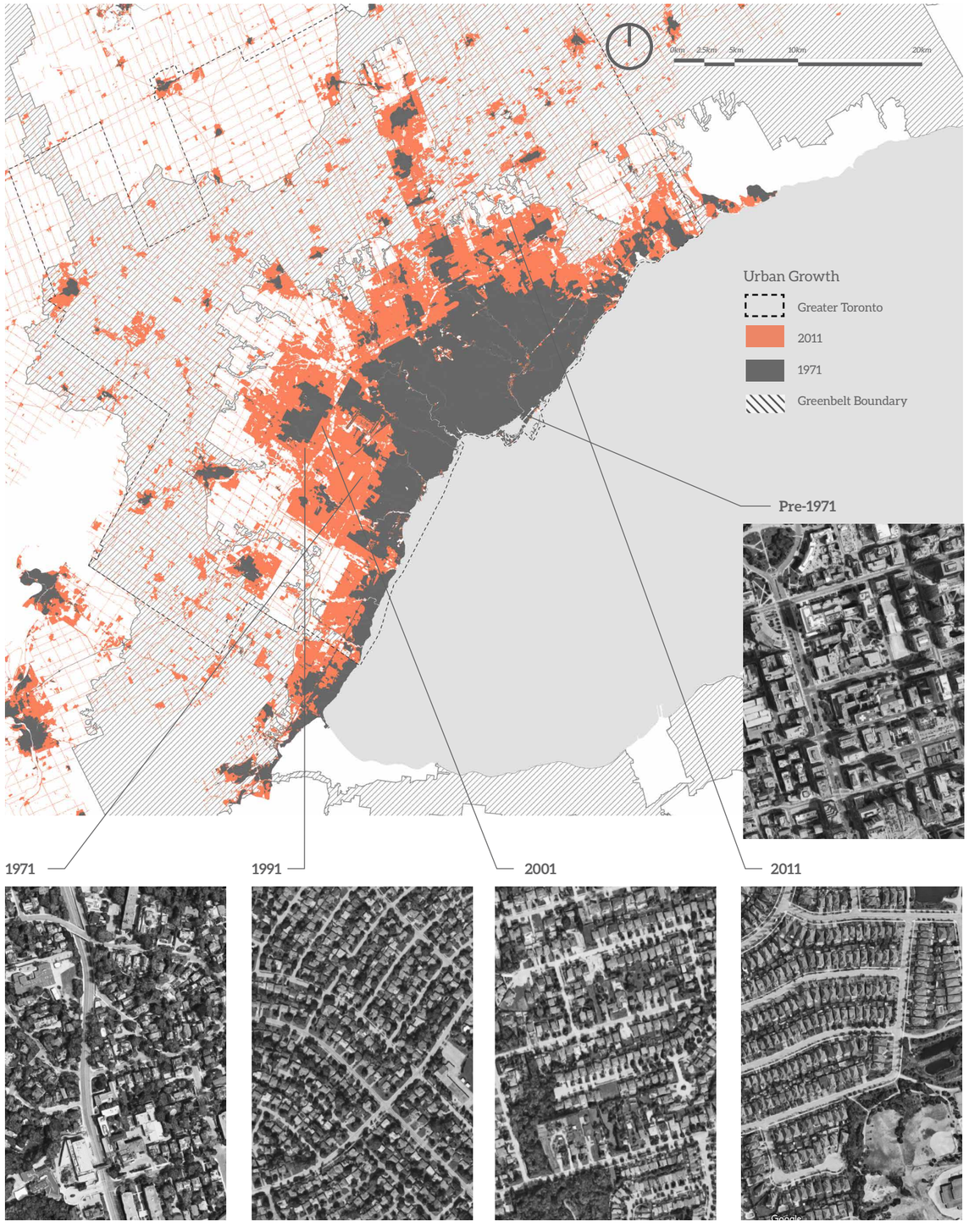


Figure 9 Fifty Years of Growth in Greater Toronto. *Source: Google Earth & Census Canada Built-Up Land Registry*

Changes to Residential Densities

Distributed Density

The distributed density of the GTA is somewhat unexpected. While it is common to make two general classifications of 'suburban' and 'urban' areas, the GTA is much more complex. As seen in figure 8, suburban development has significantly changed over the past 50 years. Many 'suburban areas contain central areas of intensification, or more commonly, highly dense greenfield developments in the peripheral regions. The density in new development was initially required in order to reduce sprawl, but has caused new issues for servicing, demand, and transport. These issues will be further looked into in the proceeding chapters.

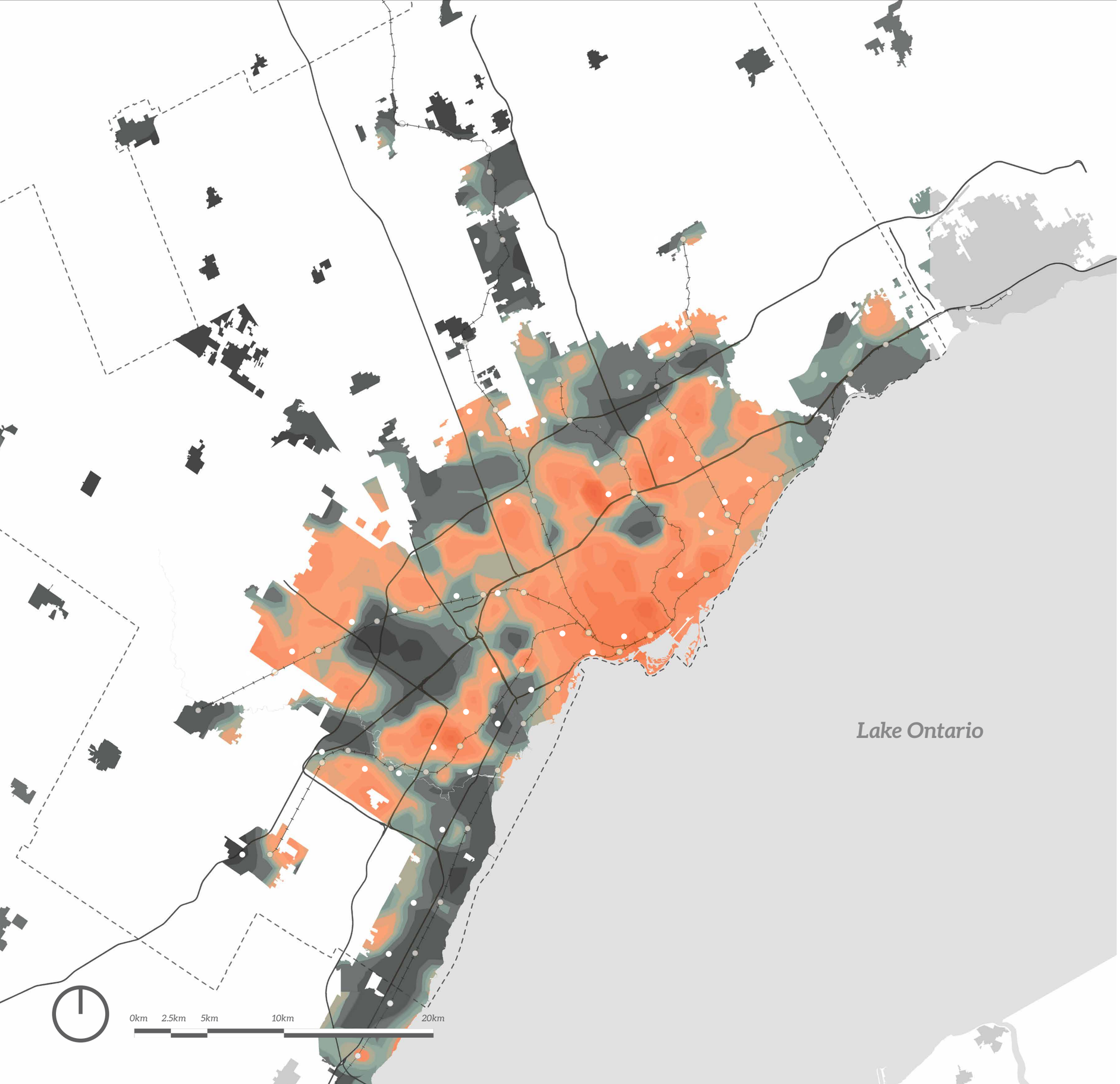


Figure 10 Density. *Source: Census Canada 2016*

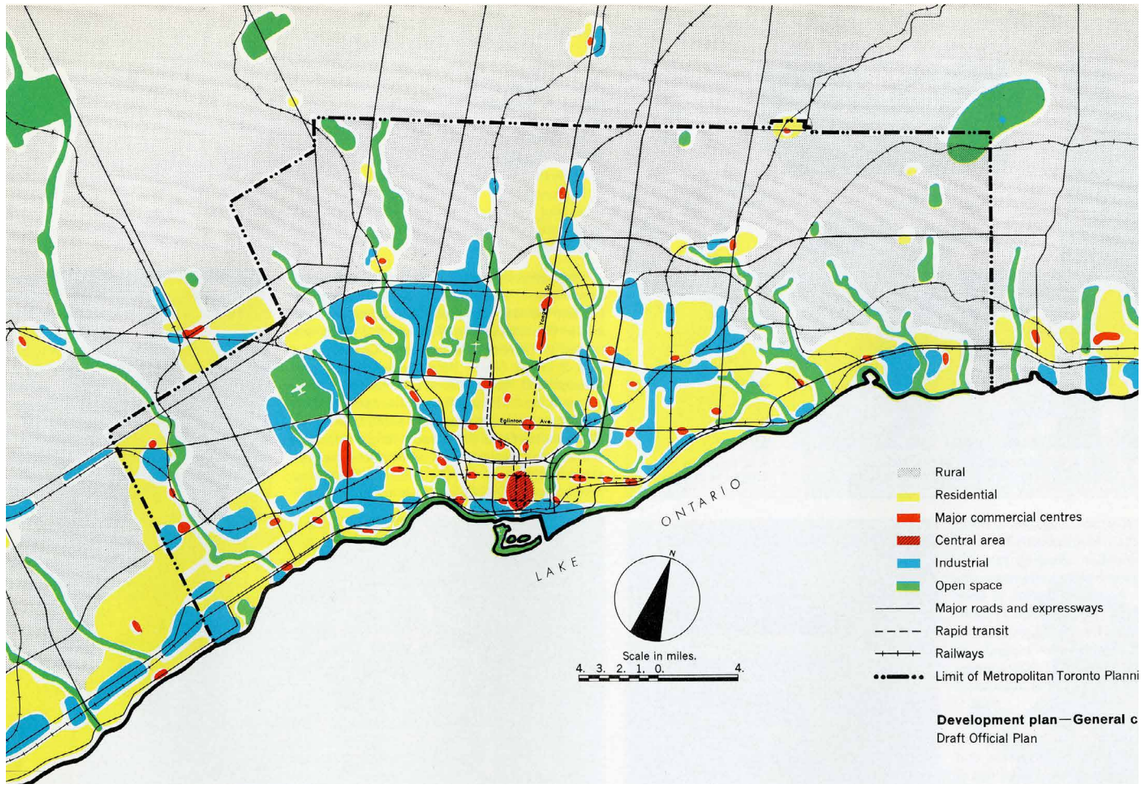


Figure 11 Metro Regional Plan 1963. *Source: University of Toronto Library Archives*

Regional Practice of Combating Sprawl in Toronto

As previously noted, Toronto had already seen a moderated regional planning department for development in the in the later 20th century. This resulted in generally organized and planned infrastructure and compact development. From the 1940s to the early 1970s, there were two distinct regional planning programs which were attempted (White, 2007). The more notorious of which was the metro regional planning which occurred during the 1950s and 1960s (White, 2007). The most notable influence of this planning regime was its ability to avoid 'leapfrog' development - the process of developing in areas exterior to the Greenbelt surrounding the city. Leapfrogging development is known to be a classic suburban issue within American contexts, often leading to mismanaged infrastructural systems and environmental damage. As one can see in the regional vision above, the plan was also unique for its time. In an era of modernist ideals of separation of uses and automobile oriented modes of transit, the plan did focus ont the introduction of large highway infrastructure throughout the urban region, but it also focused on the polycentricity of the city, allocating new central areas and rapid transit lines connecting the city. Due to political strides, the regional planning association was diminished and planning was left up to the 2 tier municipality system.

Surprisingly, the extended opposition towards regional planning was interrupted during the period of a Conservative government. The Premier of the time, Mike Harris, brought local governments and stakeholders into the new regional planning process, and introduced regional planning on the provincial level (White, 2007). This planning structure was then built upon by the following Liberal Leadership, morphing into the Places to Grow Plan we see today.

Places to Grow: An Ambitious Plan

It is important to note: the following sections and proposals are based upon criticisms and suggestions of the existing Places to Grow Plan. Nonetheless, the Places to grow plan was successful in introducing regional policies into the Toronto region with unprecedented ambitions for the GTA (White, 2007).

> *"The new growth plan proposes not just to plan the region, but to change it: to re-direct development from the urban edge into existing urban areas, to encourage new suburbs to be built as "complete" live/work communities" and to establish a multiplicity of urban centres and corridors that do not yet exist" (White, 2007, p. 5).*

"The Growth Plan in its current form remains focused on the problems of the 20th century, not those of the 21st." *The Neptis Foundation, 2017*

2.3 Inadequate Policy
Ontario Policy Approaches to Sustainable Suburban Development

Section of Author's Research Paper Submitted for DiPPid AR0069 2018

Suburban Development within the GTA is not a new problem - neither are the solutions. The suburbs have been at the centre of many urban planners' angst over the past half-century (Grant, 2009). Attempting to control suburban development comes with a sense of futility, as the developments are continuously controlled by market value and consumer demand (Grant, 2009). Still, their management has become a considerable preoccupation municipal and private urban planning offices (Grant, 2009). Construction projects are largely run by urban planners which have been trained to incorporate values such as mixed-use, densification, vibrant urban spaces, walkability, and Transit-oriented Development into their work, principles which are distant from current suburban design (Grant, 2009). This has part of the incentive of planning bodies to integrate **New Urbanism, Smart Growth, and Sustainable Development** planning principles into provincial policies. These policies have been passed down from the Provincial Policy Plan (PPP), placing the responsibility on municipalities to translate them into land-use controls and zoning by-laws. "The suburbs produced at the end of the process thus reflect a complex interplay of provincial policy, municipal politics and regulations, and market preferences." (Grant, 2009) 15. Thus far, in most municipalities, these policies have essentially failed their goals to control density, create vibrant centres, and develop sustainably within the GTA (Grant, 2009).

Sustainable development, a seemingly immense theory has found its way into many policies across the country. The interest in this practice began to influence planning approaches in Canada and Europe after the publication of the Brundtland Commission report (Grant, 2009). "Though theorists presented differing interpretations of sustainability (e.g.,Rees, 1990; Van der Ryn & Calthorpe, 1986), in planning documents and discourse sustainability rapidly became a mantra" (Grant, p. 3, 2009). Generally, the discussion centred around creating compact form, increasing sustainable transport options, creating healthy living environments, affordable housing, and creating environmental responsibility (Grant, 2009). Such vast practices and concepts were fused with other theories and policies in the 1990s, eventually fusing with the ideas of Smart Growth and New Urbanism (Grant, 2009).

The concept of **Smart Growth** began to emerge in the 1990s in American planning circles and gained a strong momentum in U.S. states (Eidelman, 2010). Its origins stemmed from a series of documents developed by the American Planning Association and the Natural Resources Defense Council (Ewing & Meakins & Bjarnson, Grace & Hilton, 2011). The term "smart growth" originally was a response to the "no growth" slogan from environmentalists who were protesting urban expansion, especially suburban growth. The solution was to preserve open and natural areas, redevelop and densify in core areas, and promote mixed land uses and town centres in less urban areas (Ewing, et al., 2011). The principles of Smart Growth were intended as the name infers to - control suburbia which threatened to grow into natural, agricultural and open space. By 2001, Canadian public figures and newspaper coverage began to clasp onto the idea of smart growth (Eidelman, 2010). By this time in Ontario, public awareness of urban sprawl had grown substantially and public concerns of environmental degradation, long commute times, and traffic congestion all added to the need for a new strategy (Eidelman, 2010). Following this discussion, the government used incentives like density bonuses or grants, reports, and manuals, and adopted a Places to Grow legislation in 2006.

New Urbanism is another ' recent' development in planning which became popularized in North America for the development/redevelopment of suburban neighbourhoods. It is closely related to Traditional Neighbourhood Design and Smart Growth with a different focus point. New Urbanism uses design principles which were common before automobiles dominated urban form (Ewing, et al., 2011). At its core, it promotes sustainable transport, increased density, better connectivity, and enhancing the central core of neighbourhoods (Ewing, et al., 2011). Though similar to smart growth, New Urbanism is framed through an aesthetic approach, often implementing its principles through form-based code and increasing the vibrancy of neighbourhood centres. Its precursors include the development of seaside Florida and drew proponents substantially related to the works of Jane Jacobs and was pioneered by Duany and Plater-Zybrek (Grant, 2009). By 1993 these ideas merged at the Congress for the New Urbanism. The Ontario government used several strategies to promote new urbanist values, as the province was involved in projects like Cornell (in the GTA) and was also linked to the Places to Grow legislation in 2006.

Sustainable Development, Smart Growth, and New Urbanism originally differed in terms of the role of governments, the importance of aesthetics, the role of ecology, and whether intervention takes place on a regional or local level. Still, their resulting principles can and would easily fuse together into Ontario's Places to Grow policies which remains until current day. However, while theorists took the time to establish what would make a good community which would then shape urban planners' goals, consumer preference eventually controlled developer practices which were translated on the ground (Grant, 2009). Though the planning process in Ontario includes negotiations with developers, public input, recommendations from the council, and a decision from the municipality, developers have established a legal right to

develop their land, and municipalities are incentivized by development fees to take what they can get. Though new urbanism, smart growth, and sustainability are always within the conversation, in policies and plans down to the municipal level, most Canadian suburbs are far from what those plans entail - the majority still turn out as low-density car-oriented communities. This is mostly due to municipalities, who are more than ready to attract investment and tax revenues from low-density land development in their area (Eidelman, 2010). Municipalities have yet to manage the prevailing growth patterns which are currently in the hands of the developers, as it is far easier and inexpensive to develop greenfield suburban land, rather than to deal with the struggle of dense urban development (Eidelman, 2010). The need for funds for municipalities and the demand from consumers has created a political environment which regional planning and control is extremely difficult (Eidelman, 2010). Driven by local economic interest from politicians, public officials, developers, and other private investors, suburban municipalities in Ontario have become centres for all growth which generates positive returns on investment (Eidelman, 2010). This has put controlling suburban growth in the hands of the Provincial government, who has already proven to lack the policies to implement change in development.

> "Regional planning and growth management strategies to curb the spread of low-density suburban development in Southern Ontario have historically been in short supply, both at the municipal and provincial levels of government. Unlike in Europe, where local administrations have access to considerable fiscal and political resources, Canadian municipalities have enjoyed only limited political autonomy and administrative capacity." (Eidelman, p.1217, 2010)

Growth Policies in Ontario

Planning Goal	*Policy Mechanism*	
Urban Containment	Greenbelt Plan (2005)	*- Designated Protected Zones for the GGH Greenbelt*
	Growth Plan for Greater Golden Horseshoe (2006 & 2017)	*- Municipalities determine designated urban settlement areas for 2031*
	Oak Ridges Moraine Conservation Plan	*- Designated Protected Zones for the GGH Greenbelt*
	Niagara Escarpment Plan	*- Designated Protected Zones for the GGH Greenbelt*
Intensification	Provincial Policy Statement (1996)	*- Municipalities target 40% of growth for residential development* *- Creation of Urban Growth Centres with a minimum of 150-400 people plus jobs per hectare by 2031* *- Growth encouraged along transport corridors and station areas*
	Growth Plan for Greater Golden Horseshoe (2006)	
Regional Land Use and Transportation Planning	Metrolinx (2006)	*- Organization responsible for coordinating implementation of the Growth Plan* *- regional coordination with multiple local transit agencies including fare and service integration for transit planning*
	The Big Move (2008):	*- regional transportation plan*

Figure 12 Source: Adapted From Neptis, 2017

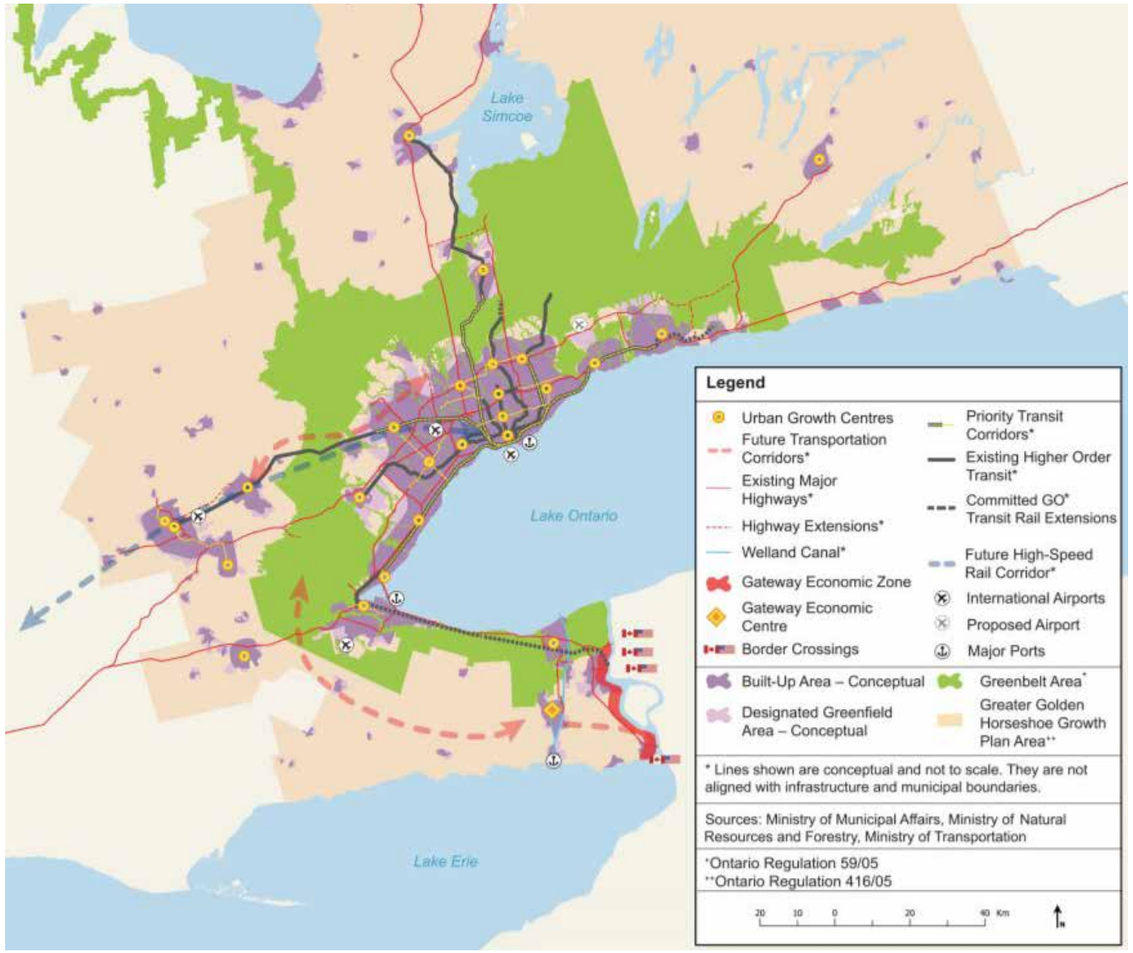


Figure 13 Places to Grow Schedule 11, 2017

Places to Grow Plan Greater Golden Horseshoe

The Places to Grow Plan was set out in 2006, for the Greater Golden Horseshoe (GGH) combined principles of Smart Growth, New Urbanism, and Sustainable development as a strategy for growth within the regions. In order to improve urban sprawl, the province set a series of growth principles, including transit oriented design, established designated growth boundaries, designated growth centres, and encouraged transit-oriented planning.

Nonetheless, in the GTA, land use planning and transit planning appear to be very separated (Neptis, 2017). Municipalities began to transform their policies after the release of the plan in 2006, two years before the 'Big Move' regional transit plan was released. As a result, accommodations around growth were not actually planned for frequent transit service (Neptis, 2017).

The Growth Plan has also been criticized for lacking the resources to meet the needs of individual municipalities and the region as a whole (Neptis, 2017). Municipalities harbour the responsibility for implementation and there are little requirements that these bodies work together within the region to meet these targets, even considering the wider regional implication (Neptis, 2017). Therefore, a policy or regional plan set out by the provincial government gives municipalities little incentive to act as a whole, other than providing intensification numbers. The main monitoring tool that has been set in place has been the 14 municipal indicators to monitor its effectiveness.

Within the past 10 years, almost 86% of new dwellings have been built via greenfield development outside of the province's planning zones. This has caused the composition of the housing stock to remain remotely unchanged (Neptis, 2017). Where intensification has occurred within the plan's growth centres, it is often with already car-oriented neighbourhoods. Figures 20 & 21 reveal that many growth centres are still within areas that are primarily car oriented, and areas which still require longer commutes to separate municipalities.

Even with the Growth Plan, the GTA struggles to grow through intensification, not greenfield development.

Figure 14 Source: Growing Pains, Neptis Foundation, 2017

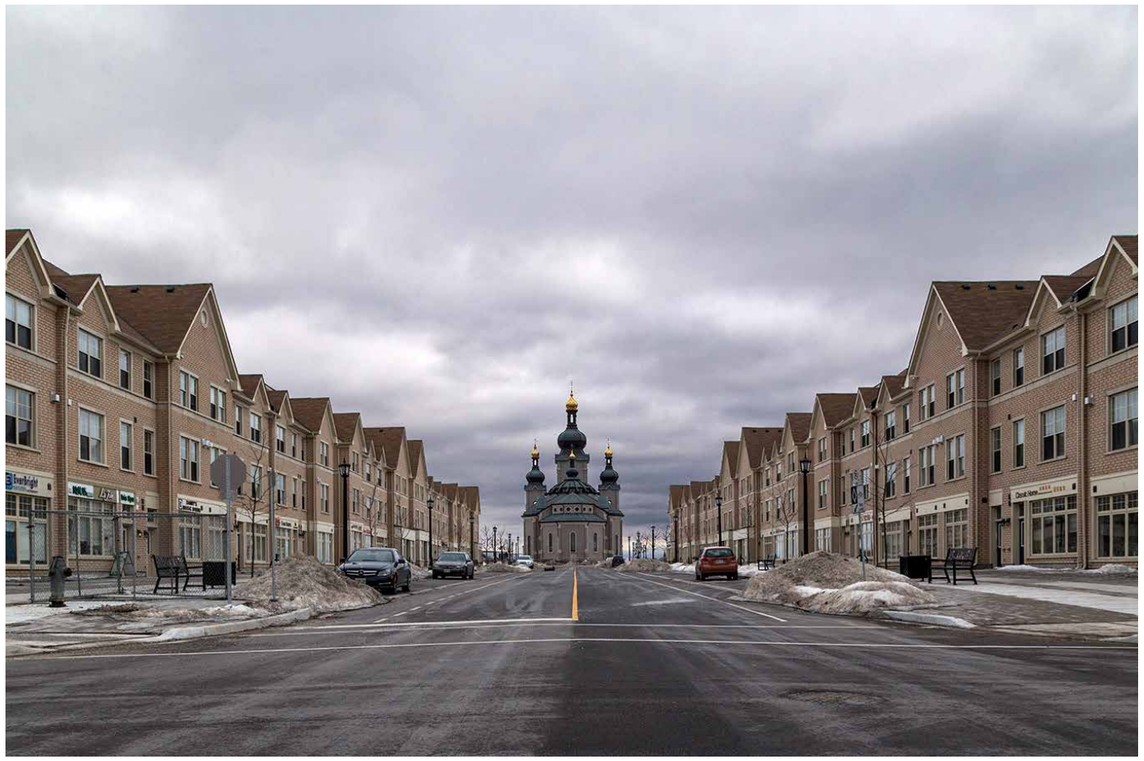


Figure 15 Markham New Urbanism Cathedral Town Development. *Source: Toronto Star*

Density ≠ Sustainability

The Growth Plan policy has been developed under the assumption that density and intensification, simply results in transit use, reduced traffic, and overall sustainable neighbourhoods (Neptis, 2017). The results from the growth plan over the past 12 years have failed to prove this through implementation of this policy. If compared to the 1970s and 80s, the GTA is no longer expanding at an instable rate, and the density of suburban neighbourhoods has increased substantially. Yet, dense housing typologies are still being constructed within traditional network designs, with car orientation, backyards, and single family housing units.

"The GTHA is no longer "sprawling" according to the traditional definition of this term. However, the problems associated with "sprawl" remain, since the majority of the new population is being accommodated in automobile-dependent neighbourhoods. Meanwhile, new problems have emerged: smaller households, older households, emptying neighbourhoods, unused infrastructure in some places and overused infrastructure in others. It is time for planning policy to evolve to address the growing pains of fast-growing city-regions.As an often-quoted saying has it: The future is not what it used to be." (Neptis Foundation, 2017, 19)

If an 'intensification anywhere' approach has failed to achieve provincial goals of the GTA, how can suburban growth move forward in a sustainable way?

Figure 16 Maple Newmarket GO Historic Station. *Source: Photography by Sean Marshall*

2.4 Identifying Sustainability in the GTA

Macro Consumption and Production Findings

If density does not necessarily result in sustainability, then what does? How can we identify methods of urban planning, design, and land use regulations which will result in sustainable change? In order to answer these questions, this research intends to start with macro data: ecological footprint and biocapacity. This is some of the most current and consistent data which is available on a provincial and regional level. Ecological Footprint quantifies the demand that human consumption and waste generation places on our biosphere, by measuring the area of biologically productive land and water that is needed to produce all the resources humans consume (Global Footprint Network, 2010). Though criticized by environmental scientists in the past, Ecological Footprint (EF) has become one of the most influential efforts to be able to weigh ecological problems in a spatial sense (van den Bergh & Grazi, 2014). The following is a brief analysis on the conditions of ecological footprint and biocapacity within Ontario.

2.5 Ecological Footprint and Biocapacity

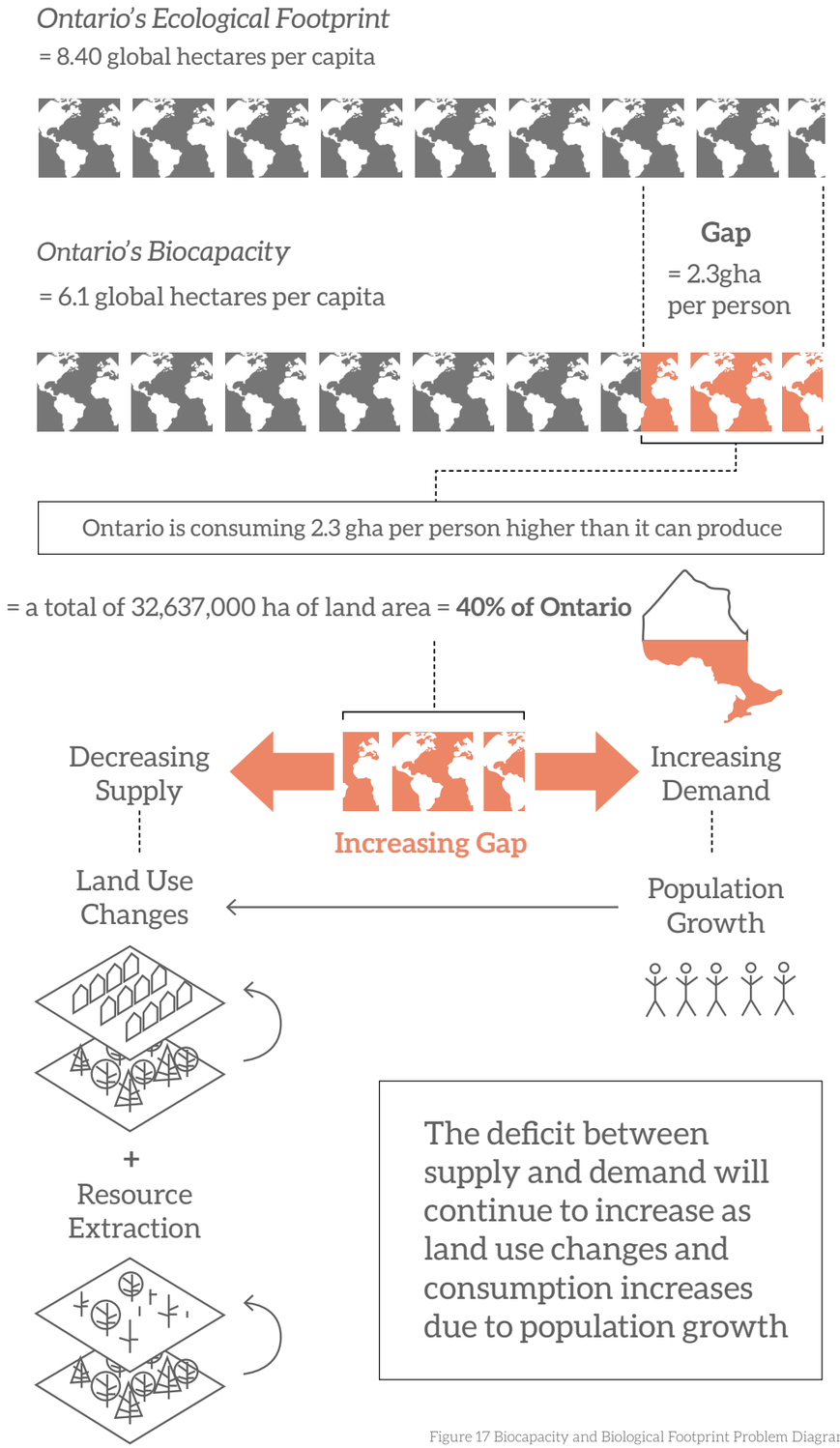


Figure 17 Biocapacity and Biological Footprint Problem Diagram. *Source: Province of OntarioBiodiversity 2010 Report*

Ontario's Ecological Footprint Breakdown

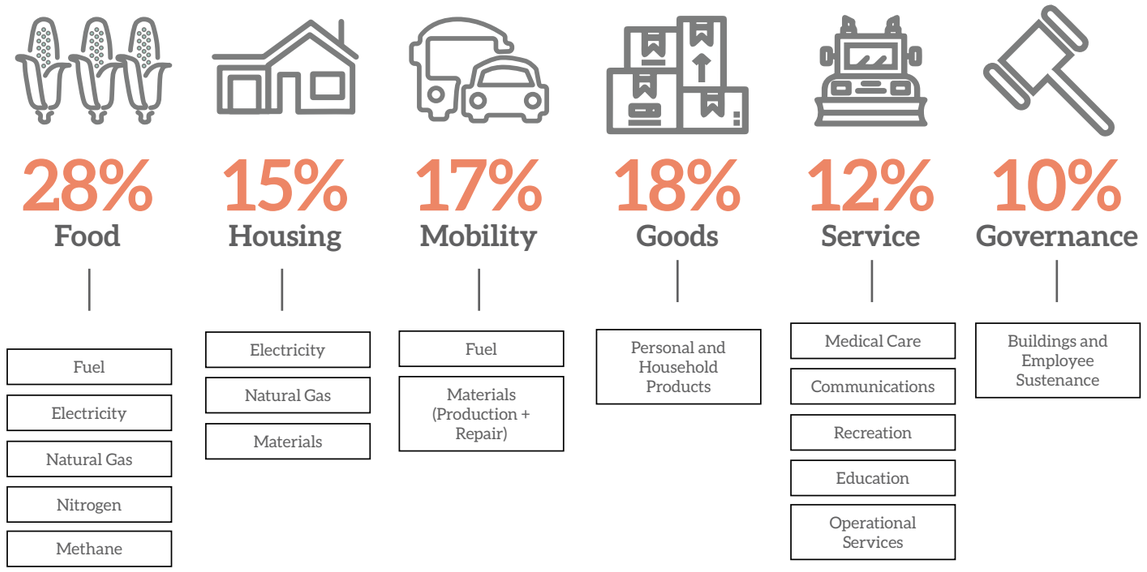


Figure 18 Biocapacity and Biological Footprint Ontario Breakdown. *Source: Province of Ontario Biodiversity 2010 Report*

Does urban form affect the different contributors to ecological footprint? Can spatial design reduce Ecological Footprint of Ontarians?

Detached Housing Average Ecological Footprint

Semi-Detached Housing Average Ecological Footprint

Apartments Average Ecological Footprint

Figure 19 Footprint by housing type Canada. *Source: Ecological Footprint Analysis Of Canadian Household Expanding Boundaries : Systems Thinking For The Built Environment Ecological Footprint Analysis Of Canadian Household, (June).*

Percentage of Single and Semi-Detached Homes

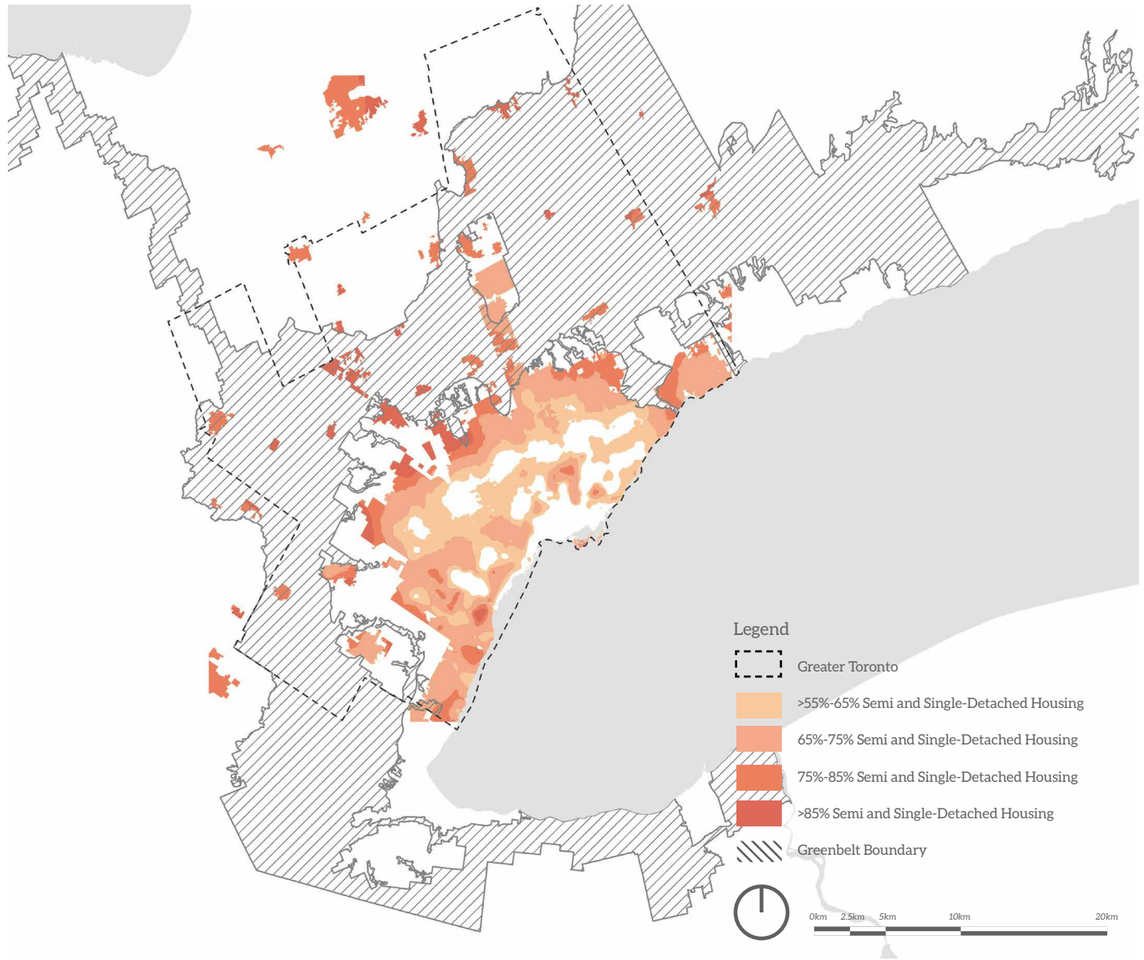


Figure 20 Percent of Semi and Single Detached Homes Source: Statistics Canada 2016 Census

Varying Ecological Footprint can be due to various demographic changes between those who occupy different dwelling types such as age, family size, origins, and income. Nonetheless, these dwelling types are prominently located in the outer regions of the GTA - especially within the regions which are projected to accommodate the majority of future growth

The relatively high ecological footprint of Ontario is shown broken down within figure 9. As can be seen, food accounts for the largest portion of the footprint of the average Ontarian (Global Footprint Network, 2010). The next footprints which are close behind include goods, mobility, and housing.
The question arises: does urban form affect the different contributors to ecological footprint? A study suggest that single and semi-detached homes have a high footprint on average (Grunewald & Ouellet-plamondon, 2016), whereas apartment have up to half the EF average as detached housing. Though this points only to housing type - according to the study the income, the size of the household, and the location of the dwelling are the most important factors of ecological footprint analysis. In Canada, even if households spend more money on housing and services, the main share of EF is from transportation and food (Grunewald & Ouellet-plamondon, 2016). Especially for those living in detached houses, usually located outsides of cities, neighbourhoods have been fairly car-oriented (Grunewald & Ouellet-plamondon, 2016). This has had a large impact on the connection between housing type and EF. Canada also imports a large food supply, and spend a large amount on food in the average household (Grunewald & Ouellet-plamondon, 2016). The connection between food consumption and housing type has not been directly connected, other than the possibly higher incomes associated with detached housing. As seen in Figure 11 these housing types are often condensed within the same locations within the GTA. Though the data is still available on a macro scale, it indicates that there are directly spatial problems associated with ecological footprint.

Ontario Ecozones

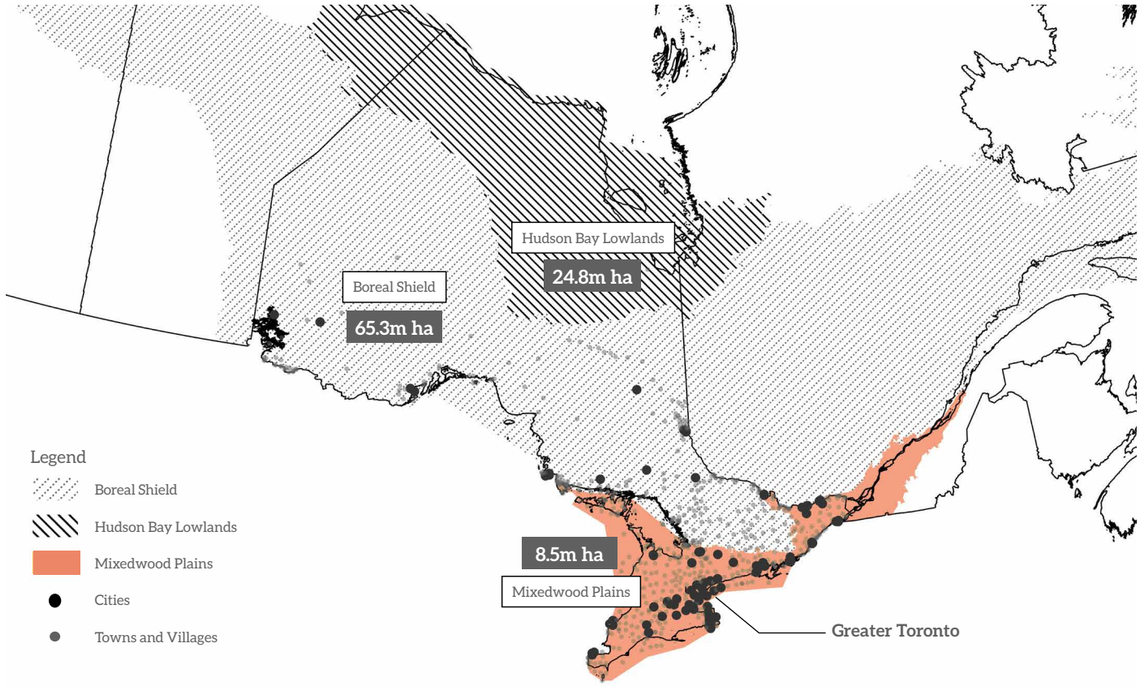


Figure 21 Land Index Information Southern Ontario. *Source: Census Canada Analyzer Datasets & Canada Land Index Dataset*

Ontario's Biocapacity

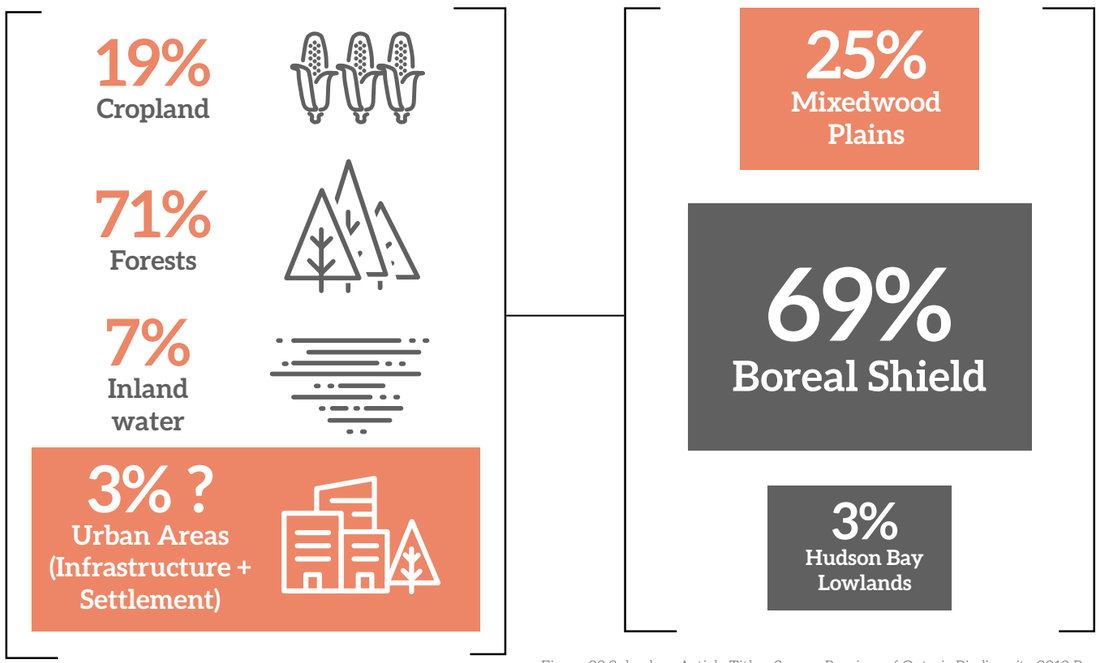


Figure 23 Suburban Article Titles. *Source: Province of Ontario Biodiversity 2010 Report*

Agricultural and Urbanized Southern Ontario

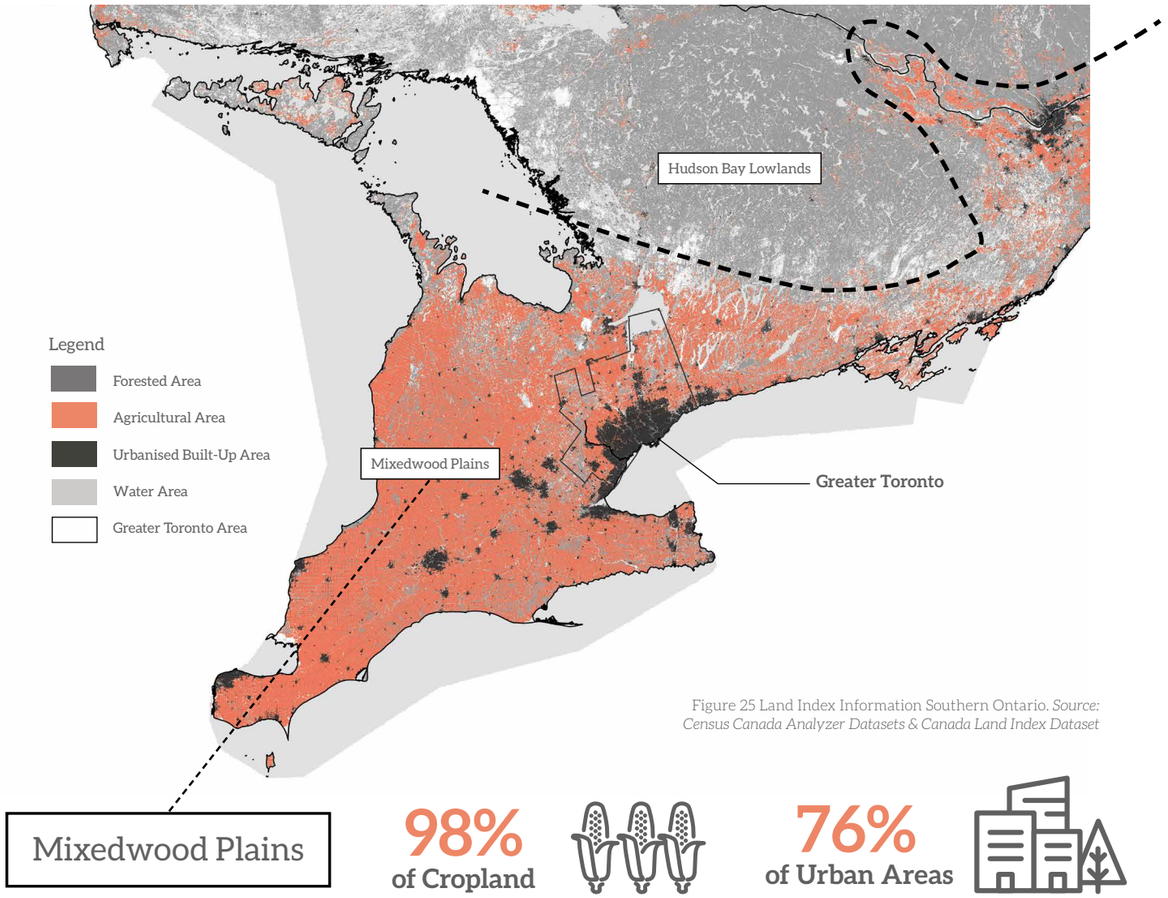


Figure 25 Land Index Information Southern Ontario. *Source: Census Canada Analyzer Datasets & Canada Land Index Dataset*

Figure 24 Source: Province of OntarioBiodiversity 2010 Report

The GTA falls within the southern Mixedwood Plains Ecozone, known as the most bioproductive landscape in Ontario as a whole, with almost all of the agricultural land and 76% of built up land (Province of Ontario, 2010). Future population growth in the province will only make matters worse, while increasing the ecological footprint The GTA falls within the southern Mixedwood Plains Ecozone, known as the most bioproductive landscape in Ontario as a whole, with almost all of the agricultural land and 76% of built up land (Province of Ontario, 2010). Future population growth in the province will only make matters worse, while increasing the ecological footprint and decreasing overall biocapacity. This will widen the gap to achieve an equal amount of supply and demand. Considering the GTA accounts for half of the current and future population of Ontario and contains the highest biocapacity zones, the GTA must manage consumption levels and reduce the overall consumption of resources and land which is threatening its biocapacity. Considering the global uncertainties in a resource scarce future, it is critical to achieve a sustainable balance between supply and demand, increasing the resiliency of regions. and decreasing overall biocapacity.

As the biocapacity in Ontario 'decreases' due to greenfield development, can urban areas accommodate more biocapacity?

2.6 Consumer Demand

Despite the attempts to curb growth, consumer choice still continues to dominate the market. Due to the soaring prices of Toronto housing, and the cultural tendencies to move towards home ownership, detached owned homes are still the most sought after housing typology. Figure 25 reveals that single family homes are preferred by 65.5% of the home buyers population. Figure 24 is a loose translation of the housing which has been offered through greenfield development at 62% of the developed housing stock. Despite how much the size of units and 'quality' of suburban neighbourhoods have changed, residents still are flocking to the same housing typologies. This is a crucial limitation for change. As municipalities bend towards the needs of real estate development, real estate development is providing supply for the unmistakable demand of suburban housing types. Developers state that there is a huge mismatch between new growth regulations and the demand supply (Nichola Saminather & Matt Scuffham, 2018).

New Urbanism and Smart Growth principles often ignore principles centred around the standards of living within individualistic societies such as in North America. A key problem to address within this research is to establish how to maintain a standard of living in suburban areas while also living sustainability, if at all possible. Or, to focus on the future of living quality considering values of resiliency in uncertain resource quantities and environments.

How can suburban development become more sustainable whilst sustaining a high quality of life?

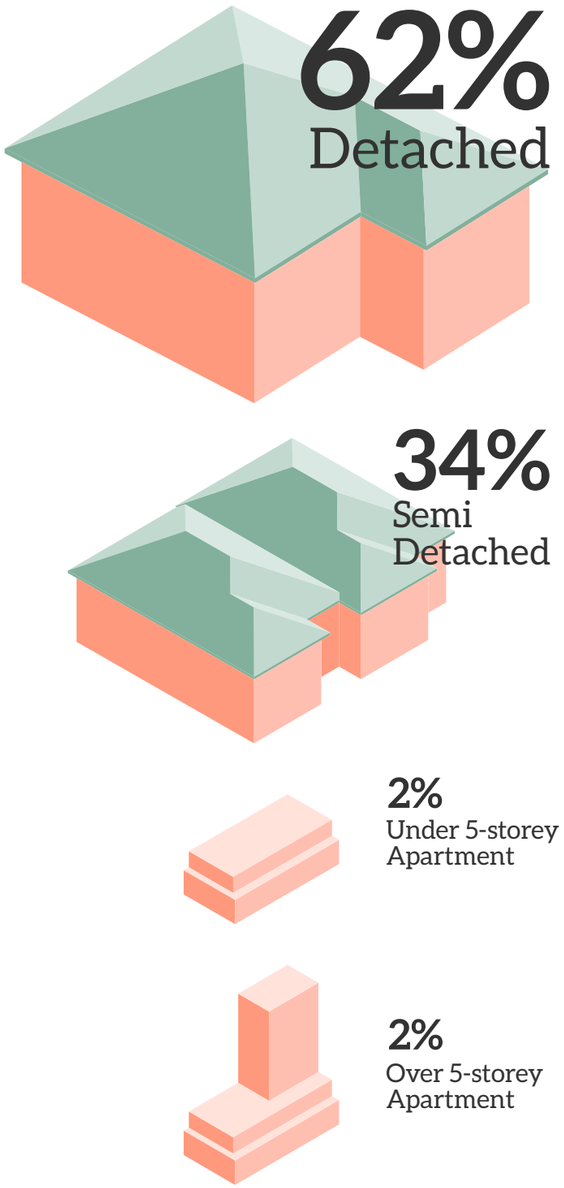


Figure 27 Composition of dwelling stock added in greenfield areas.
Source: Neptis Foundation, 2017

Figure 28 GTA Housing Construction. *Source: 'Macquarie thinks housing will drag Canada into a recession as bad as the financial crisis in two years — and that's the best-case scenario', Financial Post, May 2018*

Figure 23 Richmond Hill Yonge Street. Source: Why Richmond Hill's Court Victory Over the OMB is a Big Deal for all GTA Cities, 2018

3.0 Methodology

3.1 Introduction

The previous chapter has identified a number of critical challenges that the Greater Toronto Region will face as a result of the projected population growth in the coming years. This has included a decrease in the region's biocapacity, an increase in the consumption of resources (ecological footprint), and a policy environment which has thus far been unsuccessful in creating a shift towards a more sustainable and resilient Greater Toronto Region. This problem development has also recognized a gap within the discourse of sustainable 'suburban' regions in Canada, and a need to resolve the conflicts between theory and practice within Provincial Policy. Addressing such wide issues including sustainability, livability, resource management, and the definitions of 'suburbia' within one project calls for a methodological framework which focuses on the crucial challenges to be addressed. The purpose of this chapter is to establish the focus and intent of the thesis research, to identify the appropriate methods for analysis and design, and to create a realistic schedule for the project in relation to the methodological steps. To do this chapter will identify the:

- Problem Statement
- Research Question
- Research Sub-questions
- Research Aims
- Expected Research Outcomes
- Conceptual Framework
- Proposed Research Approach
- Conclusions and Ethical Considerations

3.3 Problem Statement

Within its current and anticipated state, the Greater Toronto Region will face a rising ecological footprint and a declining biocapacity due to population growth and suburban development practices. This has been unaided by a lacking provincial policy that has been unable to control such practices due to demanding consumer preferences driven by a need for a high quality of life and unwillingness from local municipalities.

3.4 Research Aim

The proposed project is intended to develop a regional growth plan for the Greater Toronto Area which will identify solutions beyond the traditional densification, intensification, anti-growth, or transit-oriented design approaches. It is vital to recognize some of the successes of these theories within practice, but also move beyond the traditional assumptions which they are based on such as the associations between 'unsustainability' and suburban development. This calls for a more complex understanding of what sustainability means within peripheral territories. While these approaches have already been heavily criticized in the realm of planning, solutions regarding sustainability and traditional suburban development have yet to be provided in the North American context. The project intends to add onto the existing approach to suburban sustainability by first looking beyond the standard classifications of urban-suburban-rural morphologies within the GTA. Once a more complex understanding of the region is formed, sustainable solutions will be explored using methods of Urban Metabolism studies, making broader connections between the spatial factors of the region, and the high consumption rates of resources and proposing possible spatial solutions to these complex problems.

3.2 Research Output

The outcome of my thesis research refers to the first sub-question: What research output can best achieve these outcomes? The three main outcomes which are set within my research question are: bridging the gap between provincial policy and municipal allowance, reducing ecological footprint while increasing biocapacity, and maintaining a quality of life. Achieving the first outcome of 'bridging the gap', provides an outlook for my research output. In the Greater Toronto Region, the distance between provincial and municipal governance in spatial and political terms is vast. This has created a large gap between urban theory/policies set out by the Province of Ontario and the suburban development which is put into practice by municipalities and developers. Looking at this gap from a planning perspective offers an opportunity for a the scale of regional design which provides a bridge between theory and practice. According to Neumana & Zonneveld, Regional design takes place in a setting where an entire range of boundaries has become blurred, whether between spatial boundaries, actors, or other dynamics (2018). A regional design may create a more comprehensive vision where the existing structure of local and regional governments cannot match

3.5 Research Question

How can a Regional Spatial Strategy bridge the gap between provincial policy and municipal allowances to plan sustainable suburban growth which will lower ecological footprint, increase biocapacity, and maintain a high quality of life in the Greater Toronto Region?

Sub-Questions

1. What research output or "plan" can best achieve these outcomes?
2. What are the general current challenges Toronto is facing including: economic, social, and environmental issues?
3. What are the future projections and future projects for growth and development within the region?
4. What policies have been proposed to tackle growth, sustainability, and resiliency? Where are they successful, and lacking?
5. Are the highest resource flows in the region (food, housing, mobility, goods) influenced by spatial design in the peripheral regions?
6. How can suburban development become more sustainable whilst sustaining a high quality of life?
7. What possible solutions can regional spatial design offer for the reduction of resource consumption and waste when accommodating growth?
8. How did the regional spatial strategy use principles of sustainability, urban metabolism, and resiliency to develop a sustainable suburban growth process?

the complex interactions between locations (Neumana & Zonneveld, 2018). In addition, they note:

> *"Regional design has the virtue of clarifying, at least in part, necessary changes in the governance of city-region development by focusing on strategic spatial characteristics. Strategic ones are selected because they induce growth and shape form and structure. These strategic matters that in many regional designs are spatially expressed by infrastructure are thus subject to investments that can spur economic activity and ecological restoration. By contrast, regulation and other development controls are more apt for smaller urban scales such as the municipality and specific projects. It is the larger scale and the associated level of complexity – in terms of governance as well as spatial structure – which distinguishes regional design from urban design." (2018 p. 3)*

The choice of a regional plan was not only inspired by scale, but by the history of planning in the region. The Toronto region. In fact, Toronto had moderated a regional planning department for development in the 1950s and 60s and the result, was a tightly linked municipal investment infrastructure with connecting sewer and water supply systems (Hess et al., 2015). The development controls regulated by the planning body ensured that roads, sidewalks and sewers were paid for by developers, and parks spaces were also set aside within their development blocks (Hess et al., 2015). Some researchers argue that it was the Metro Toronto Regional Planning system which led Toronto to have moderately compact and planned suburbs in comparison to Canada's American counterparts (White, 2014). Nonetheless, the metro regional planning department had diminished by the late 1960s due to political strides and development control fell into the hands of local municipalities. This research output seeks to return to regional planning in design in a region that is already so interconnected as a result of previous regional planning. Considering the opportunities within the current context, and the proven successes of regional design in the past, a regional plan is seen as the most appropriate output to achieve the project goals.

3.6 Conceptual Framework

The regional plan provides an output which can address the gap between governance scales as identified within the research question. However, the outcomes concerning consumption, biocapacity, and standards of living remain unanswered. In order to address these issues, the project will use methods within urban metabolism approaches in order to identify the relationships between material flows and space in the GTA. To address livability and quality of life, design studies which consider the regional structure and material flows will be developed in order to explore opportunities to resolve conflicts between sustainability and livability. This combination of concepts can be seen within the conceptual framework below, and also within the methodology onwards.

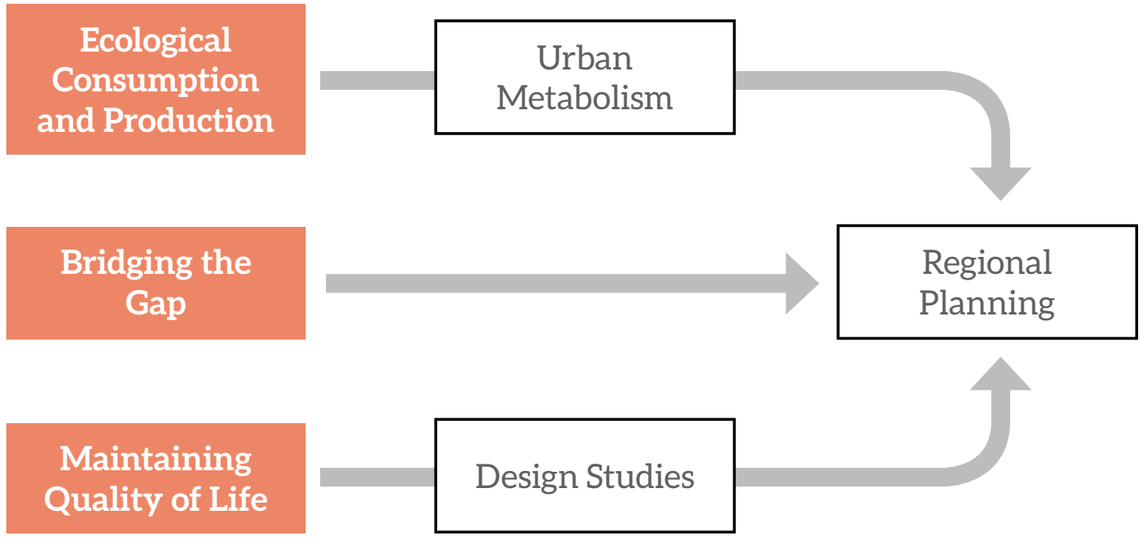


Figure 30 Conceptual Framework

3.7 Research Framework

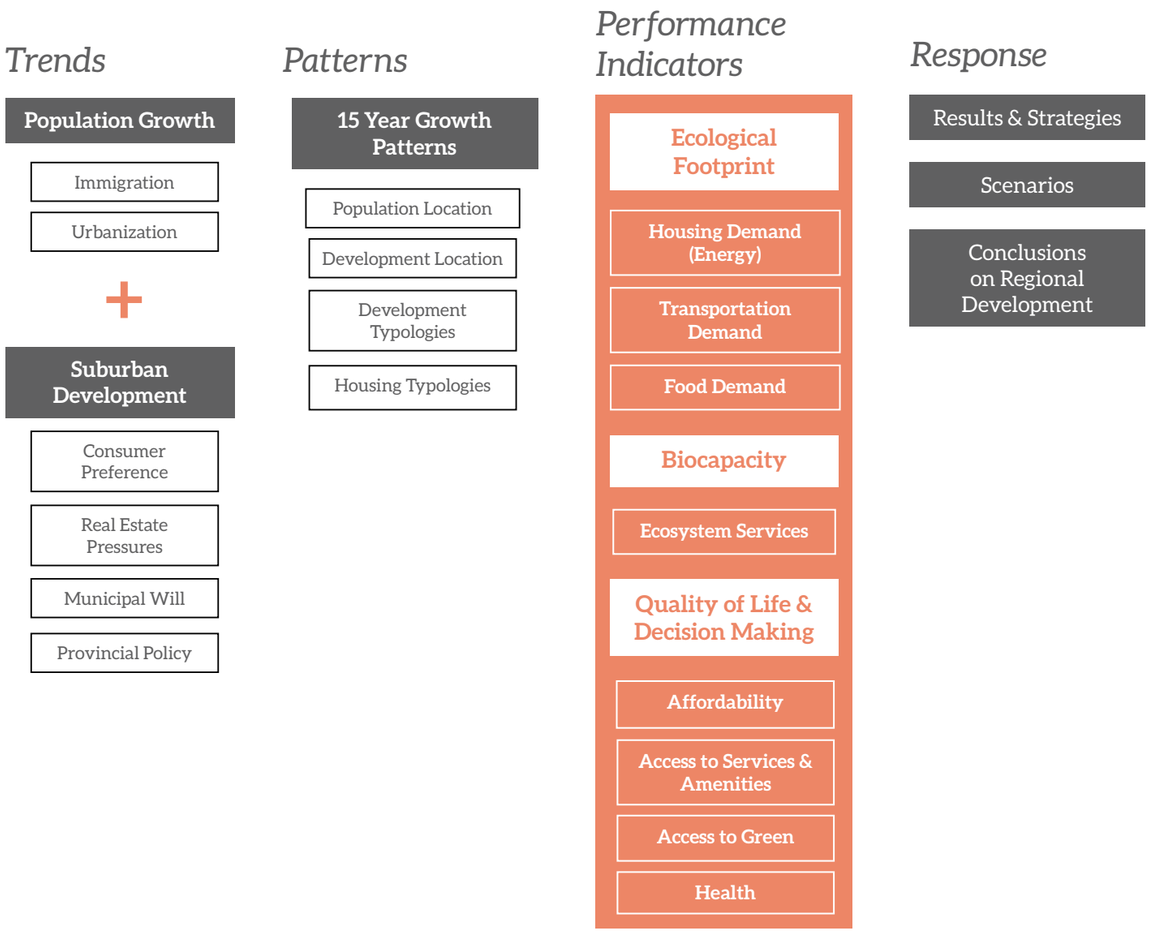


Figure 31 Research Framework

Research Approach

To conceptualize and frame the problem further, this research will follow a framework which seeks to draw connections between current trend and growth patterns which have been occurring in the GTA during its recent growth. The framework provides an approach which may assist in establishing indicators which can provide performance evaluations in different types of growth in the area. The intent is to make connections between the uncontrolled trend of population growth, and the controlled variable of Suburban Development. It is intended to explore sustainability indicators which have been established using macro data such as ecological footprint and biocapacity studies, and develop them further for a more data-oriented, and place-based analysis tool. The results from the indicators analysis will result in conclusions which assist in the development of strategies for new growth in the region.

Trends

The trends which are developed include economic, social and demographic attributes which pertain to growth. The trends contain the uncontrolled variable of population growth and the controlled variable of (current) suburban development practices. Population growth has its own instigators mainly including immigration, urbanization, and a minorly decreasing birth rate. Suburban development can be simplified into three factors: consumer preference, real estate pressure, Provincial Policy, and Municipal will which regards the ability of municipalities to control the development practices on the ground.

Patterns

The patterns which will be explored are the growth arrangements which have occurred due to the processes of population growth and suburban development. This will include the locations where population has been distributed, the forms of the development that took place including street networks, city form, and housing types. Ideally, 'growth types' will be established in order to rank their performance based on the sustainability indicators.

Performance Indicators

The indicators are the practices which place the highest pressures on our urban system and environment in order to provide resources for inhabitants and visitors. These pressures can be broken down to increased housing demand, increased transportation demand, and increased food domain as the main resulting impact from population growth and suburban development. These specific pressures have been derived from data on ecological footprint. However, not every consumption activity necessarily represents the same scale of affect. Research points towards three distinct consumption categories as the major problem areas: housing, transport, and food (Holden & Norland, 2005). These three issues are also those which can be addressed within urban form and land use planning. Therefore, these three indicators of consumption will be used as the major contributors to the unsustainable practices in the region.

Consumption is not the only issue which indicates negative effects from suburban development practices. The ability for the adjacent part of the region to produce is dwindling due to land use conversion of agricultural areas, many of which contain the highest quality soils in the province. Large spanning developments call for more converted agricultural land, as well as increased demand for infrastructure which will impact surrounding ecosystems. In order to explore the effects of land use conversion, the research will use the Ecosystem Services concept to offer a rounded approach to addressing the potential changes to ecosystem values rather than a single quantification of "productivity".

In order to beyond quantifications of sustainability within production and consumption, it is vital to delve into the primary driver of suburban development: the balance between perceived quality of life and affordability. This part of the research intends to explore the demographics of where people are living, the current affordability of different growth patterns and the physical spaces which they occupy which may have an affect on resident's quality of life. Understanding the standards and conditions which cause expansion to the suburban areas of the GTA can shine a light on how the improvement of sustainability indicators can also maintain and improve living quality for residents.

Response

The response to the indicators analysis will include conclusions based on the findings within the report as well as strategies based on these finding. The strategies will be geared towards the identified growth patterns, as the opportunities and constraints may differ per development type. The project will then create 'What if' scenarios in order to test these strategies in specific locations within the GTA. The scenarios will include an exemplary design in the target locations in order to show examples of implementation, but also to create conclusions on the potential challenges and opportunities within different strategies. The conclusions for each scenario will partake in larger conclusions and reflections on how the region should plan to grow in the future in order to develop a more sustainable and resilient pattern.

3.8 Methods

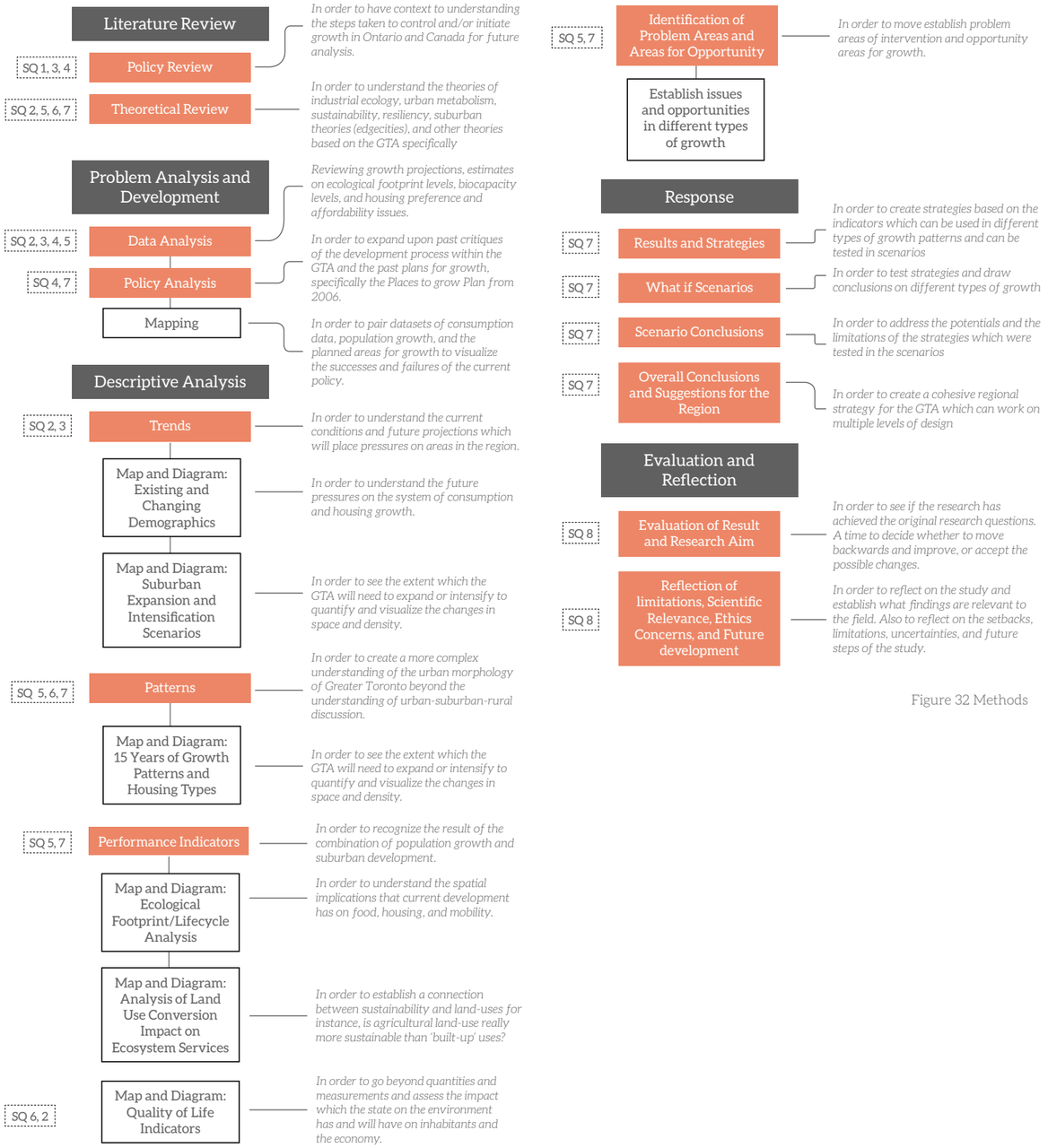


Figure 32 Methods

3.9 Overall Approach & Methodology

During this research project, I intend to use a mixed method approach, which focuses on collecting quantitative and qualitative data to integrate different perspectives between macro data and evidence in practice (Creswell, 1996). Using this method, I will establish objective theories on suburban development and urban metabolism and test them through the examination of social and human factors within the region. Most importantly, I have used the DPSIR framework as a key component of my Descriptive Analysis and Design study in order to frame the discussion with the relevant subjects and indicators in mind.

Literature Review

The intention of the literature review is to gain better understanding of the current (and past) discourse centred around suburban growth and anti-growth, as well as methods and theories used in urban metabolism studies to effectively analyse the flows of resources in regions/territories.

Outputs
- Theoretical Paper
- Idea Development

Problem Analysis and Development

The problem analysis and development is to explore and solidify the initial problem statement, recognizing assumptions and creating an evidence based focus. To achieve this the research will first include data analysis, reviewing growth projections in the GTA, reviewing ecological footprint data, biocapacity data, and data on current housing development.

Outputs
- Data Visualizations
- Mappings
- P1 Report

Ecological Footprint

Some of the most current and consistent data which is available on the provincial level is the ecological footprint analysis of Canada, Ontario, and the Census Region of the GTA. Ecological Footprint quantifies the demand that human consumption and waste generation places on our biosphere, by measuring the area of biologically productive land and water that is needed to produce all the resources humans consume (Global Footprint Network, 2010). Though criticized by environmental scientists in the past, Ecological Footprint (EF) has become one of the most influential efforts to be able to weigh ecological problems in a spatial sense (van den Bergh & Grazi, 2014).

While criticisms of EF remain crucial to the use of the data, the studies acquired in this research provide indicators which can assist with a snapshot of consumption and production in Ontario, pointing to possible problems which can be deconstructed on a more detailed level. Therefore, Ecological Footprint data has been used to identify a problem within Ontario and the GTA.

Biocapacity and Ecosystem Services

Biocapacity is used to measure the maximum productivity of resources in the landscape. Similar to the EF studies, biocapacity measurements are widely available on the macro level, generally on the provincial scale. The problem development has used this data to provide a general idea of the biocapacities of Ontario, but it is clear that these statistics will need further analysis within the Descriptive Analysis to explore the current inaccuracies and possibilities for biocapacity measurements in urban settings. In order to explore the effects of land use conversion, the research will use the Ecosystem Services concept to offer a rounded approach to addressing the potential changes to ecosystem values rather than a single quantification of "productivity". The concept of Ecosystem Services (ES) is intended to establish the interdependent relationship between humans and the ecosystems in which they reside (Nicholls, Hutton, Adger, Hanson, Rahman & Salehin, 2018). Humans are often thought of as separate from nature, whereas ES intend to place people as part of the natural environment and therefore should be managed as such. This concept focuses on the range of services that ecosystems may provide to humans, as well as what the system uses to support itself as a whole (Nicholls et. al, 2018). ES can be separated into four general categories (Ronchi, 2018):

- Provisional (ex. food, water, fuel)
- Regulatory (ex. flood and atmospheric regulation)
- Cultural and Recreational (ex. recreational parks and tourism)
- Supporting (ex. nutrient cycling, biodiversity, habitat)

Policy Analysis

The Problem Development will also include a policy analysis, specifically from the Ontario Provincial Policy Plans, which recognizes the aims of the policies. The analysis will also include a review of the existing critiques of the policies, most significant being the policy suggestions produced by the Neptis Foundation.

To visualize this information, maps will be developed to pair datasets from the data analysis with the planned areas for growth to recognize the successes, failures, and future challenges of suburban development.

Outputs

- Data Visualizations
- Mappings
- Conclusions of Problem Areas and Opportunities for Growth
- P2 Report

Descriptive Analysis

Growth Patterns Analysis

The intention of the growth patterns analysis is to create a more complex understanding of the urban morphology within the Greater Toronto Area beyond the basic understanding of urban-suburban-rural. "It is evident that suburbs have been changing. Internationally, many suburban areas have gone through a significant evolution from the process of dispersal to densification, increasing the complexity and diversity of different regions" (Charmes & Keil, 2015). Settlements have been coined as 'ex-urbs', 'edge cities', and technoburbs' and have been signs of new suburban settlement types. These new settlement identifications have often been lumped in with the classification of 'post-suburban' (Phelps & Wood, 2010). In the European context, Wandl, Nadin, Zonneveld and Rooij (2014) used the term Territories-in-Between (TiB) in order to include the concepts laid out within Zwischenstadt (Sieverts, 2003) città diffusa(I) (Indovina, 1990),annae-hernd perfekte peripherie (CH) (Campi, Bucher, & Zardini,2000), peri-urbanité(F) (Le Jeannic & Vidalenc, 1997) (Wandl, 2017). These increasingly dynamic settlements have changed the historic morphologies of concentric cities and have developed into more polycentric and more fragmented regions, creating thin lines between 'urban' and 'suburban' areas (Charmes & Keil, 2015).

The intent of this analysis is not to debate between the post-suburban or new suburban landscape in Toronto, but to attempt to define the morphological features of the region with these concepts in mind. In order to map the GTA given these concepts, I will identify map features in a similar to that within the Netzsadt Method (2003) while also including the concept of the historico-geographical approach as defined by Oliveira, Monteiro & Partanen, 2015. The Netzstadt Method defines the map features for analysis as Nodes, Connections, and Borders as being

Morphological Analysis Breakdown

Feature	Element	Categories	Source
Nodes	Transit Stations	GO Train Stations; TTC Stops; Via Rail Stations; Viva Stops; Regional Bus Transit Stops	Public Transit Provider; Metadata; Ontario Open Data; Regional Open Data; Open Street Map
	Shopping Centres	Highly Populated retail and commercial uses within one plot	Ontario Open Data; Regional Open Data; Open Street Map
	Employment Centres	Highly Populated commercial and office uses within one block	Ontario Open Data; Regional Open Data; Open Street Map
	Highway Access	Major Access to 400-series highways	Ontario Open Data; Regional Open Data; Open Street Map; Google API
Connections	Ecological Corridors	Rivers; Streams; Watershed Corridors; Greenbelt Connections	Ecology Toronto; Ontario Open Data; Regional Open Data; Open Street Map
	Transit Networks	GO Train Lines; TTC Lines; Via Rail Lines; Viva Lines; Regional Bus Lines	Ontario Open Data; Regional Open Data; Open Street Map
	Highway Network	400-Series Highway Connections	Ontario Open Data; Regional Open Data; Open Street Map
Fields	Downtown Boundaries	Major Access to 400-series highways	Ontario Open Data; Regional Open Data; Open Street Map; Google API
	Main Street Areas (Mixed Use Downtowns)	Business Improvement Association Boundaries; Main Streets; Historic Downtowns	Ontario BIA Association Online Mapping Ontario Open Data; Regional Open Data; Open Street Map
	Mixed Use Areas	Areas defined to have (or construct) ground floor retail or commercial uses, with residential and/or office uses above	Municipal Land Use; Municipal Zoning Regulations; Existing Address Data (Open Street Map)
	Mono-functional Commercial and Retail (Strip Mall)	Large areas with mono-functional commercial and/or retail uses with street oriented parking	Municipal Land Use; Municipal Zoning Regulations; Existing Address Data (Open Street Map)
	Conservation Areas	Oak Ridges Moraine Greenbelt Classifications	Ecology Toronto; Ontario Open Data
	Agricultural Land	Agricultural land defined by Canada Landstat; Crop Types	Canada Landstat
	Land Open for Expansion	Non-conserved Land as Laid Out by the Province of Ontario	Ontario Growth Plan Data
	Residential Areas	High-Density Residential Mid-Density Residential Low-Density Residential Residential	FSI Calculations Existing Zoning and Land Use Plans
Borders	National	Neighbourhood	
	Greater Golden Horseshoe	Plot	
	Greater Toronto Area and Hamilton	Block	
	Greater Toronto Area		

Figure 33 Morphological Analysis

part of an overall urban System (Oswald, Baccini, & Michaeli, 2003). Nodes are stated as the locations marked by a high density of people, goods, and information, Connections as flows of people, goods, and information between nodes, and Borders as the spatial, temporal, or organizational demarcations of the network. The second concept of the historico-geographical to morphological analysis can define the region as an area through distinctiveness using tools such as ground plan, building fabric, and land utilization, and regionalization (Oliveira, Monteiro & Partanen, 2015). I will use these (more traditional) measurements to add to the nodes, connections, and borders with an additional term of "Fields". Table 1 is used to define these features within the growth patterns analysis

Trends Analysis

The intent of the Trends Analysis is to understand the current conditions and future projections which place pressures on areas within the region. In order to do this, we refer back to the DPSIR framework and recognize that demographic changes and suburban development practices are the main drivers for the problem statement. In order to further define the drivers, the existing and changing demographics will be mapped within the region these maps will include density conditions and changes, population breakdowns, and the projected numbers for immigration into the city and where.

Pressures Analysis

The intention of the pressures analysis is to describe and explore how the drivers are placing force on the state of the environment. To do this, we will take our two main Pressures: Consumption pressures from population growth and Land Use Conversion Pressures from suburban development. To review consumption pressures we will move beyond the ecological footprint analysis and produce a compilation of the contributors to emmissions within each indicator, as well as a spatial analysis of the relation to urban form. Much of the flows within the region have been collected by the Toronto City Summit Alliance within multiple reports. None of which has been made spatial using GIS software to discover the geographical qualities to the data. Within this section, I will take the data from these reports, among others and create a spatial analysis of how urban forms are affecting these indicators. The next portion of the analysis will include a review of the effects of current land use patterns on general sustainability and developing indicators which may recognize the inconsistencies within theoretical assumptions about sustainability and built form.

Pressures Analysis Breakdown

Pressure	Element	Categories	Source	Borders
Food Consumption				
	Regional and Local Food Production	Urban Farms; Periphery Agricultural Crop Land Types; Local Farmers Markets	Ontario Open Data; Regional Open Data; Open Street Map; Google Earth; Canada Landstat	Regional Local
	International Food Production	Food imports from international sources;	Desk Research	International
	Food Processing	Ontario Food Terminal; Mid-Scale Processing Centres Grocery Stores Restaurants	Desk Research Open Street Map Google Earth	Regional Local
	Transport	Major industrial vehicle network to Processing Centres	Google API; Ontario Open Data	National Regional Local
	Waste Diversion	Compost; Landfill; Recycling		
Mobility	Space Syntax Road Network	All roads within network	Open Street Map	Regional Local
	Commuting Zones	Major Employment Centres; Areas with high densities of commercial, office, and retail	Ontario Open Data; Regional Open Data; Open Street Map	Regional
	Ownership of Vehicles	Census Tract Ownership Data	Statistics Canada	Regional
	Walkability and Bikeability	Sidewalks; bike lanes; Plazas; Obstructions: Highways, Rail Lines, Water; Facilities and Amenities	Ontario Open Data; Regional Open Data; Open Street Map	Regional Local
	Major Industrial Transport Lines	Highways Dedicated Industrial Transport	Ontario Open Data	Regional
Housing	Housing Type and Size	Census Tract Data	Census Canada	Regional Local Plot
	Housing Age	Census Tract Data	Census Canada	Regional Local Plot
	Newly Planned Housing Projects	Census Tract Data	Census Canada	Regional Local Plot
	Electricity Usage	Census Tract Data	Census Canada	Regional Local Plot
	Natural Gas Usage	Census Tract Data	Census Canada	Regional Local Plot
Land Uses	Land Uses	Agricultural High-Density Residential Mid-Density Residential Low-Density Residential Residential Mixed-Use Commercial Office Conservation Area	Census Canada	Regional Local Plot
Ecosystem Services	Water Quality Water Supply Habitat Atmospheric Regulation Recreation and Cultural Soil Retention	Canada Land Cover Data	Scholars GeoPortal Canada	Regional

Figure 34 Pressures Analysis Breakdown

Identification of Problem Areas and Areas of Opportunity

Nearing the end of the Descriptive Analysis, a set of indicators will be selected based on the findings. These indicators will assist in the selection of problem areas and areas of opportunity for growth. These indicators must be established with the evaluation of the plan in mind. The indicators must also be able to assess the proposed plan to test if these solutions theoretically work.

Response

The response to the indicators analysis will include conclusions based on the findings within the report as well as strategies based on these finding. The strategies will be geared towards the identified growth patterns, as the opportunities and constraints may differ per development type. The project will then create 'What if' scenarios in order to test these strategies in specific locations within the GTA. The scenarios will include an exemplary design in the target locations in order to show examples of implementation, but also to create conclusions on the potential challenges and opportunities within different strategies. The conclusions for each scenario will partake in larger conclusions and reflections on how the region should plan to grow in the future in order to develop a more sustainable and resilient pattern.

Results and Opportunities

The results and opportunities will be drawn from the findings within the descriptive analysis. The intent of these conclusions are to develop a critical impression of the different growth types, and how they perform within each set of indicators. Their qualitiative and quantitative performance will identify problems, but also opportunities for sustainable development in the current development locations and process.

Strategies

The results and opportunities will then lead to strategy development for each of the growth type. These strategies will be based on the existing spatial condition of specific patterns considering the constraints and realities of development in the region.

What if Scenarios

The What if Scenarios are intended to test selected strategies on specific chosen sites in the region. The scenarios pose the question of, 'What if' because the end goal is to understand the possibilities and the limitations with the strategies in order to make a more educated and experimental based decision on the recommendations for future growth.

Outputs

- Reference Catalogue
- Design Experiments
- Land Use Study
- Regional Design/Plan
- Local Intervention Studies

Regional Growth Recommendations

Based on the conclusions from the what if scenarios, the recommendations are intended to summarize the research into final recommendations for different growth types moving forward. These recommendations will ideally mitigate and improve the issues that the region will most likely face with future development and population growth. Based off the insights from the descriptive analysis and design investigations, the next step is to draft a preliminary stratefy for growth in the GTA using the multi-scalar strategies as noted within the scenarios. The regional strategy will first focus on the regional vision, drawing out possibilities for growth centres or expansion areas/opportunities. The plan will then expand on how these ideal locations and expansion strategies can possibly reduce ecological footprint, preserve or increase biocapacity, and also maintain a high quality of life. This will ideally be evident through comparison to the planned expansion/intensification of the Toronto Region executed earlier in the Descriptive Analysis.

Evaluation and Reflection

To identify the success or lacking of the research project, a review of the research compared to the research questions and research aim will be conducted. This step will decide whether to move backwards and improve based on the research framework, or provide future steps for ongoing research.

Outputs

- Self Evaluation Based On Indicators set out in Descriptive Analysis

3.10 Project Limitations

Currently the project has established moderately well-known and far-reaching problems which have been the topic of discussion in Canadian planning for over 50 years. Many problems are systemic and dependent on political decisions. It is crucial to the project to build upon the past discussions, without negating their usefulness. In proceeding further, it is important to remain realistic in implementation while also rejecting and renewing previous assumptions about the possibilities of planning in Canada and Ontario.

3.11 Ethical Considerations

Similar to any regional or territorial studies, there are always risks in generalization and classifying 'types' of people, neighbourhoods, life qualities, causes of health conditions etc. Though data can be a useful tool, it is important to critically analyse the results of data collection, and the possible variation of facts in mapping to represent populations and areas in the best way possible.

Another consideration is that my hometown is a municipality in the GTAH. It is crucial to use objectivity and subjectivity in an appropriate manner, to avoid having my personal opinions affect the direction of my studies negatively.

Within the implementation of a regional strategy it is also important to understand the socio-economic effects of broad changes in policy, such as loss of jobs, income, or potential loss of land values and be both sensitive and stern to these necessary changes.

3.12 Conclusions

The Methodology Chapter has described the intentions and process of the study on the Greater Toronto Region. Addressing such wide issues including sustainability, livability, resource management, and definitions of 'suburbia' within one project calls for a methodological framework which focuses on the crucial challenges to be addressed. The purpose of this chapter was to establish the focus and intent of the thesis research, to identify the appropriate methods for analysis and design, and to create a realistic schedule for the project in relation to the methodological steps. In this way, I have defined my conceptual framework which combines regional planning with Urban Metabolism analysis and Livability/Sustainability Design Studies. I have also defined my DPSIR research framework which has allowed a multi-dimensional lens to the analysis of the projects. This can also be seen in the layout of the project methods, which use the DPSIR to fully analyse the issues in the region. The Design Study will then hope to create a mesh between Livable design and Sustainable design.

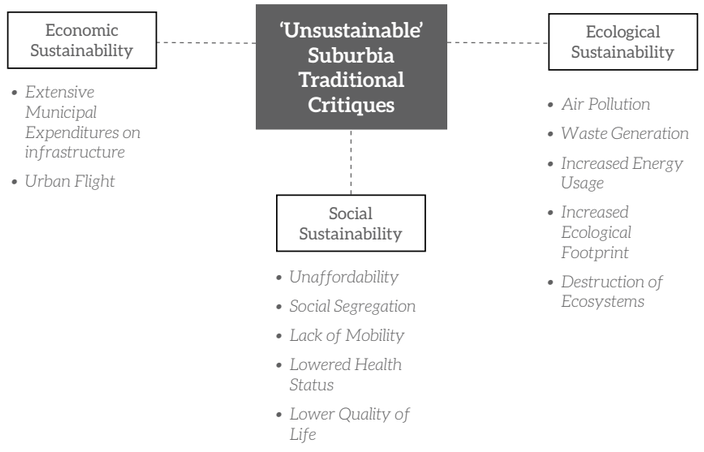
Figure 35 Mattamy Homes Development GTA. Source: Regulatory overkill is driving Canada's biggest homebuilder south, Financial Post, 2017

4.0 Theoretical Framework

4.1 Sustainability in the Suburban Discourse

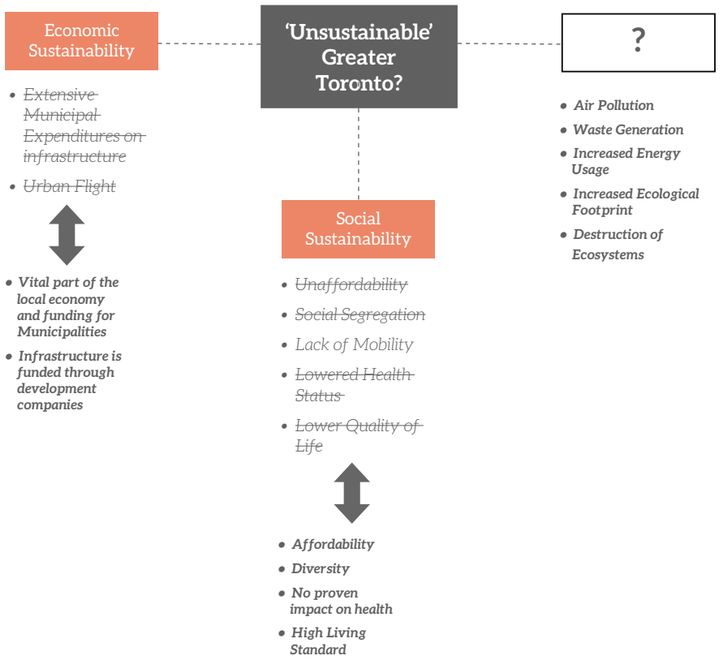
Traditional Suburban Sustainability Critiques

Generally, suburbs have been identified as unsustainable forms of development using the three pillars of sustainability: economic, social, and ecological sustainability. On the economic front, academics claim that suburbs drain municipal resources and increase urban flight from cities. Suburbs have also been held to be socially negative due to their unaffordability, social segregation, negative health impacts and lowered quality of life. The ecological sustainability includes a number of impacts including air pollution, waste generation, increased ecological footprint and the destruction of ecosystems.



The Realities of Sustainability in Suburban Toronto

While it is crucial to understand there are critical issues within suburbs in the GTA, the region significantly differs from the traditional (American) suburban condition which these critiques are based on. Both Economic and Social Sustainability has been reasonably achieved in suburban GTA areas. Suburban development is a vital part of funds paid towards municipalities through developer fees, and infrastructure is funded by these developments themselves. Toronto is also unique in that it is a extremely ethnically diverse region, is commonly considered to be more affordable, and has yet to have correlation between health issues and suburban living (Statistics Canada, 2016). Arguably, the economic and social successes within the region has drawn the focus away from ecological issues, which still prevail through development typologies.



4.2 Post-Suburbs

"It is evident that suburbs have been changing. Internationally, many suburban areas have gone through a significant evolution from the process of dispersal to densification, increasing the complexity and diversity of different regions" (Charmes & Keil, 2015). Settlements have been coined as 'ex-urbs', 'edge cities', and technoburbs' and have been signs of new suburban settlement types. These new settlement identifications have often been lumped in with the classification of 'post-suburban' (Phelps & Wood, 2010). In the European context, Wandl, Nadin, Zonneveld and Rooij (2014) used the term Territories-in-Between (TiB) in order to include the concepts laid out within Zwischenstadt (Sieverts, 2003) città diffusa(I) (Indovina, 1990),annae-hernd perfekte peripherie (CH) (Campi, Bucher, & Zardini,2000), peri-urbanité(F) (Le Jeannic & Vidalenc, 1997) (Wandl, 2017). These increasingly dynamic settlements have changed the historic morphologies of concentric cities and have developed into more polycentric and more fragmented regions, creating thin lines between 'urban' and 'suburban' areas (Charmes & Keil, 2015).

4.3 Density and Sustainability Paradigm

Densification has been a critical part of the movement towards 'new' or 'post-' suburbanization. Densification has been a particular instrument which has been used to identify and classify changes within the suburban landscape. While the shift towards densifying these settlements has multiple contributors, urban planning trends which promote 'compactness' and 'intensification' have considerably affected such change. These trends have been dominating the contemporary planning discourse with the main objective of combating suburban sprawl, which has been widely accepted as a large contributor to climate change and 'unsustainable' living. The consistent relationship between sprawl and climate change within contemporary planning discussion has contributed to one common assumption: that density equals sustainability. Yet, while density seems to be embedded in our 21st-century planning culture, there are various inconsistencies between dense developments and sustainable living, specifically in the GTA.

Within Canada and the GTA, density 'in the name of the environment' has the ability to discredit NIMBYisms and slow local challenges against development. It seems that if one is against height, one is against the planet. This continuous use of density as a means for any urban growth has created a justification for growth coalitions and limited the discussion on sustainable suburbs. It is clear that the direct relationship between sustainability and density has been moderately discredited through recent research. In order to maintain a proper discussion around the sustainable future of suburban or post-suburban areas, planners must first develop a realistic discourse around them. Discussion must move beyond a 'density first' approach and analyse several factors of sustainability and livability to better understand actions to be taken with future growth. This is not to say that the 'compactness' which has been attempted through Sustainable Development, New Urbanism, and Smart Growth visions is entirely irrelevant, but combinations of values and the resolution of sustainability conflicts could eventually create sustainability within planning practices.

4.4 Intensification, Compactness and Sprawl

Many theories, specifically those within the 20th century, focus on the limitation of sprawl in cities. Springing up from these theories were policies which governments used to inhibit outwards growth. In North America, the most practiced frameworks included Sustainable Development, Smart Growth, New Urbanism, and Landscape Urbansim.

Sustainable Development

Sustainable development, a seemingly immense theory, has found its way into many policies across the country. The interest in this practice began to influence planning approaches in Canada and Europe after the publication of the Brundtland Commission report (Grant, 2009). "Though theorists presented differing interpretations of sustainability (e.g.,Rees, 1990; Van der Ryn & Calthorpe, 1986), in planning documents and discourse sustainability rapidly became a mantra" (Grant, p. 3, 2009). Generally, the discussion centred around creating compact form, increasing sustainable transport options, creating healthy living environments, affordable housing, and creating environmental responsibility (Grant, 2009). Such vast practices and concepts were fused with other theories and policies in the 1990s, eventually fusing with the ideas of Smart Growth and New Urbanism (Grant, 2009).

Smart Growth

The concept of Smart Growth began to emerge in the 1990s in American planning circles and gained a strong momentum in U.S. states (Eidelman, 2010). Its origins stemmed from a series of documents developed by the American Planning Association and the Natural Resources Defense Council (Ewing & Meakins & Bjarnson, Grace & Hilton, 2011). The term "smart growth" originally was a response to the "no growth" slogan from environmentalists who were protesting urban expansion, especially suburban growth. The solution was to preserve open and natural areas, redevelop and densify in core areas, and promote mixed land uses and town centres in less urban areas (Ewing, et al., 2011). The principles of Smart Growth were intended as the name infers to - control suburbia which threatened to grow into natural, agricultural and open space. By 2001, Canadian public figures and newspaper coverage began to clasp onto the idea of smart growth (Eidelman, 2010). By this time in Ontario, public awareness of urban sprawl had grown substantially and public concerns of environmental degradation, long commute times, and traffic congestion all added to the need for a new strategy (Eidelman, 2010). Following this discussion, the government used incentives like density bonuses or grants, reports, and manuals, and adopted a Places to Grow legislation in 2006.

New Urbanism

New Urbanism is another ' recent' development in planning which became popularized in North America for the development/redevelopment of suburban neighbourhoods. It is closely related to Traditional Neighbourhood Design and Smart Growth with a different focus point. New Urbanism uses design principles which were common before automobiles dominated urban form (Ewing, et al., 2011).

At its core, it promotes sustainable transport, increased density, better connectivity, and enhancing the central core of neighbourhoods (Ewing, et al., 2011). Though similar to smart growth, New Urbanism is framed through an aesthetic approach, often implementing its principles through form-based code and increasing the vibrancy of neighbourhood centres. Its precursors include the development of seaside Florida and drew proponents substantially related to the works of Jane Jacobs and was pioneered by Duany and Plater-Zybrek (Grant, 2009). By 1993 these ideas merged at the Congress for the New Urbanism. The Ontario government used several strategies to promote new urbanist values, as the province was involved in projects like Cornell (in the GTA) and was also linked to the Places to Grow legislation in 2006.

Landscape Urbanism

Landscape Urbanism is a concept which builds upon Regional Environmental Planning, popularized by the works of Patrick Geddes. Landscape Urbanism can be traced back to post-modern critiques of modernist architecture and planning (Waldheim, 2012). It proposed multiple concepts, but the strongest being that landscape, was itself, the ordering mechanism for the urban field. Within this concept, the landscape instigated growth, form, and change, in a complex and indeterminate globalizing world (Waldheim, 2012). Many contemporary Landscape Urbanism Projects took place in adapting brownfield lands, such as industrial water fronts, or creating new business parks (Waldheim, 2012). These projects would often instigate growth, neighbourhood improvements, or increase land prices such as famously seen in New York's High Line (Waldheim, 2012). Most Landscape Urbanism projects in the Toronto Region happened in and around the city centre, such as the waterfront revitalization project (Waldheim, 2012). Yet, the most significant plan which takes place outside of municipal Toronto is the Greenbelt plan itself. Though the Greenbelt Plan falls more under the realm of Regional Environmental Planning, the concept remains consistent, where the city form, may be controlled by the larger landscape itself.

During the same time, the discipline of city planning in North America moved toward the goals of New Urbanism and Smart Growth. The concepts of New Urbanism and Landscape Urbanism pose as opposites. The former, is intended to strictly prescribe form and to create layouts and buildings which represent historic forms. The latter, rejects the prescriptions of built form and focuses on landscape as the guiding form for cities.

This research project, does not argue to favor one concept over the other, but perhaps a balance of both. For New Urbanism, creating historic buildings and layouts anew has proven to be futile for developers in the GTA (such as Cathedral Town in Markham), but the concepts of mixed housing typologies, integration of mixed-use, and the aims for a walkable city still remain relevant. There must be a balance between requirements for compact form and over prescriptive land use and zoning design. There is also a clear need to focus on the regional construct of our landscape as we grow into it. The GTA must adapt beyond only creating floodplains and soccer-fields to create a more relevant network with new regional growth.

Agrarian Urbanism

Throughout the research project, the topics of agricultural idealism and agricultural integration are often discussed. These ideas have stemmed from a long history of agrarian urbanism, a concept which moves towards large scale rural living. Several projects throughout the 20th century attempted to harness this rejection of the industrialized metropolis, due to the issues caused by density and industry (Waldheim, 2012). Three major (unbuilt) project invoked the ideas of agrarian urbanism. The first being Frank Lloyd Wright's 'Broadacre City' (1934-35), the second being the 'New Regional Pattern' by Ludwig Hilberseimer (1945-49), and lastly 'Argronice' by Andrea Branzi (1993-94) (Waldheim, 2012). All three presented the radical idea of complete decentralization of cities, with individual and collective plots for city farming (Waldheim, 2012). None of these projects were necessarily realized, but the concept of city dwellers searching for a rural escape from the metropolis lived on. Of course, suburban sprawl is caused by a series of factors, but it is crucial to remember the ideal of a rural lifestyle embedded in the minds of suburban dwellers. These suburban expansions, partly as a result of this idealism, extend into agricultural lands giving residents a visual relationship between farmland and landscape. Yet, unlike agrarian urbanism, this is where the connection ends. Throughout the project, select ideas of Agrarian Urbanism will be incorporated to explore how the integration of agricultural lands can involve residents and also shape urban form.

New Ruralism

New Ruralism is a more recent theoretical concept. As the name suggests, New Ruralism intends to create a framework which will bridge Sustainable Agriculture and New Urbanism (Kraus, 2006).

> *"New Ruralism embraces the power of place-making that can help American agriculture move from an artificially narrow production focus to encompass broader resource preservation values. As a place-based and systems-based framework, the New Ruralism nurtures the symbiotic relationship between urban and rural areas." (Kraus, 2006, p.2).*

While New Ruralism is a new term and trend, the thoughts on integrating ideas of Agrarian Urbanism with more centralization, walkability, and integrated urban systems, stands to create an ideal concept for developing our outer cities.

Urban Metabolism

The concept of Urban metabolism has been used to review how cities and regions perform in regards to sustainability. Urban Metabolism can serve as a model of a city, regional, or territorial system, which can measure anthropic activities and their result (ie. output/waste) (Beloin-Saint-Pierre et. al, 2017). Through Urban Metabolism, there are still a number of methods and models which are being practiced, including methods such as Flow Analysis, Emergy Assessment, Footprint, Input/Output, Life cycle assessment, Network Analysis, and integrated combinations (Beloin-Saint-Pierre et. al, 2017). The intention of this project is not to create a model in itself, but combine the existing models and findings of Urban Metabolism studies which have examined the GTA. The intent is to take the next steps in Urban Metabolism projects, by relating these findings to urban form, in order to find data-driven conclusions and solutions for urban growth in the future in order to improve the metabolism of cities.

Urban Metabolism and Livability: Extending the Urban Metabolism Model

The project proposes to analyse and design using the themes of Urban Metabolism and Livability. In 1999, Newman introduced aspects of livability into the Urban Metabolism model in order to expand the understanding of the benefits of urban flows. As shown in Figure 37, the model shows how the basic metabolism concept includes the dynamics of settlements and livability (Newman, 1999). The intent of this research project is to draw conclusions between the dynamics of settlements, waste outputs, and livability together in order to propose solutions which increase livability and decrease waste outputs while adapting settlements.

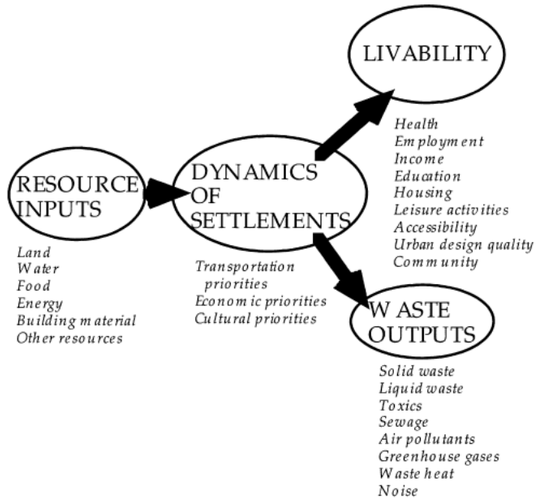


Figure 37 Extended Urban Metabolism Model. Newman, 1999.

Connecting Theories

The theories noted above, specifically New Urbanism, Landscape Urbanism, Smart Growth, and Agrarian Urbanism, have opposed or built upon each other throughout their development and growth. This research project will attempt to integrate the successful elements which stem from these concepts combining ideas such as Transit Oriented Design (Smart Growth) and the integration of agriculture in denser subdivisions (Agrarian Urbanism).

Figure 36 Mattamy Homes Development GTA. Source: Regulatory overkill is driving Canada's biggest homebuilder south, Financial Post, 2017

5.0 Descriptive Analysis

Growth Projections for the GTA

Growth in the Greater Toronto Area is projected to continue until at least 2041. Provincial projections have estimated population growth for each upper tier municipality. Within the GTA, Urban Toronto continues to accommodate the largest value of the population at 33% of the total growth. The largest and most adjacent municipalities to urban Toronto (York Region and Peel) are accommodating a significant amount of the growth. Currently, these regions have grown through greenfield expansion within the inner ring.

Region	2016 Population	2041 Population Estimate	Percentage of Population Growth Occurring in Region
Durham	691,000	1,191,000	11%
York Region	1,072,000	1,790,000	17%
City of Toronto	2,725,000	3,404,000	33%
Peel	1,350,000	1,972,000	19%
Halton	391,000	1,011,000	9%
Hamilton	510,000	778,000	7%
Total	5,807,000	10146,000	

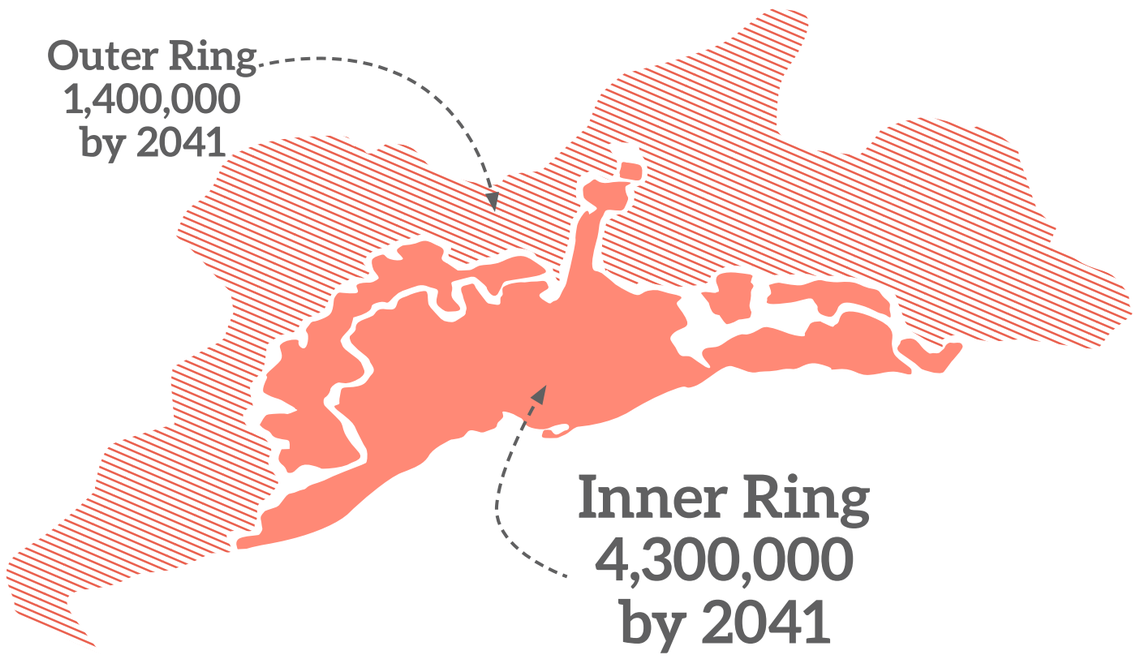


Figure 38 Neptis (2017)

5.1 Suburban Development Patterns: Fifteen Years of Growth

Urban Boundary Growth (Whitebelt)

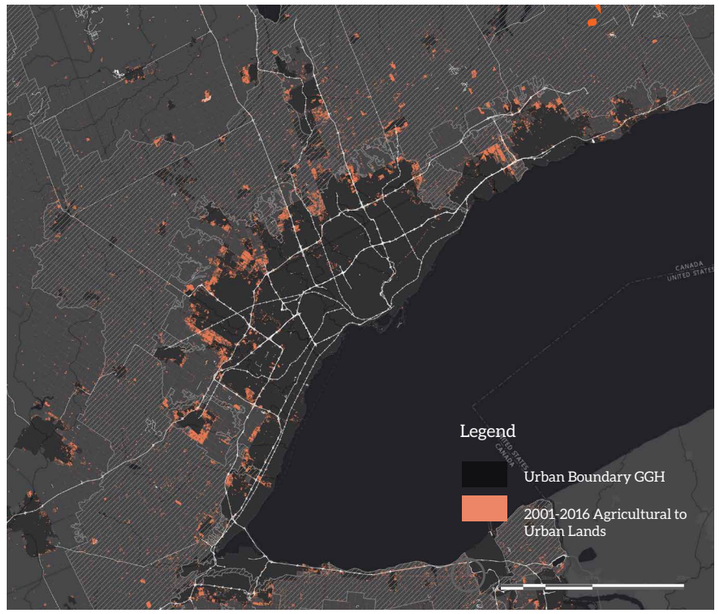


Figure 39 Greenfield Developments over the Past Decade. Source: Statistics Canada 2016 Census

Between 2001 and 2016, 86% of the population growth in the GTA was accomodated through greenfield development, but only accounted for 54% of the housing stock added to the built area of the GTA (Neptis, 2017). Greenfield development includes the lands which municipalities designate as 'urban expansion lands'. Greenfield developments primarily occur on converted agricultural lands. In order to identify the designation and development of these areas since the Growth Plan in 2001, the Canada raster Land Cover Datasets were used for the years 2001, 2010, and 2016. The lands which changed from a agricultural land cover, to a urban or road land cover were marked as the urban expansion lands within the map above.

Growth Centre Boundaries (Intensification)

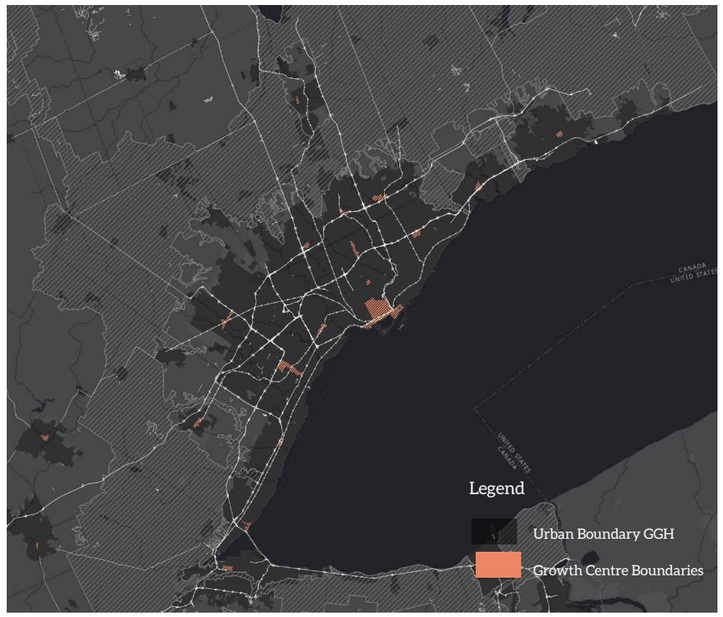


Figure 40 Percent of Semi and Single Detached Homes Source: Statistics Canada 2016 Census

The precise location of intensification growth is more difficult to delineate, but will be further explored later in this chapter. Instead, the following map reveals the Growth Centres identified by the Provincial Regional Growth Plan. These areas are intended to promote dense development in existing urban cores. Earlier in this research, we have already explored the planning of the growth centres and the discrepancies between the regional transit planning authority, Metrolinx, and the Places to Grow Plan. Later in this chapter, we will discover where the actual intensification has occurred, and if it has met the requirements of intensification within the Growth Plan.

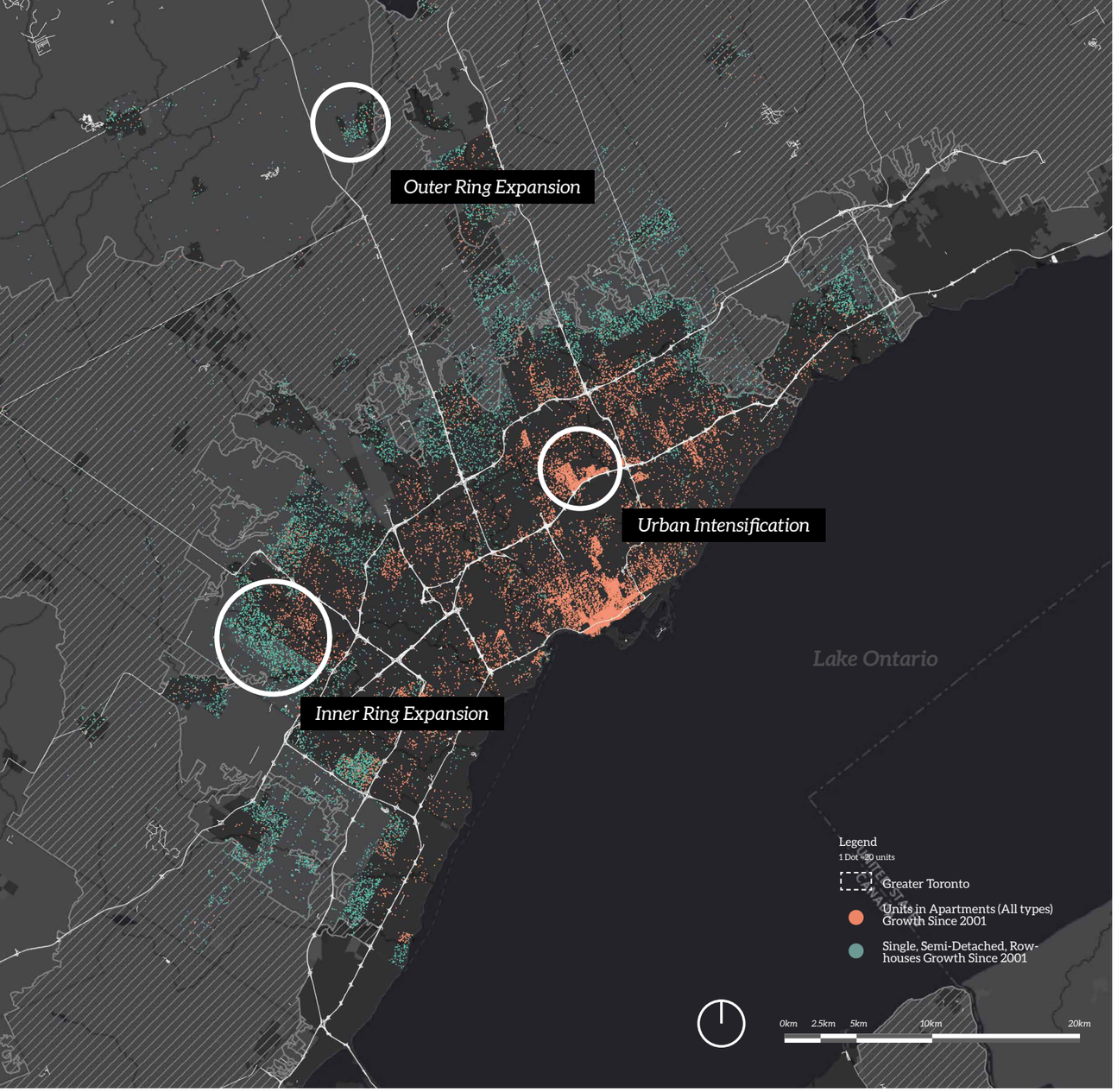


Figure 43 Urban Growth and Decline. *Source: Statistics Canada Census, 2016*

Three Growth Typologies: Urban Intensification, Inner Ring Expansion, and Outer Ring Growth

Building off the growth projections for the Outer Ring and Inner Ring, this section is intended to understand the growth types further. As an addition to the Outer/Inner Ring classification, the following map indicates the three types of growth which have generally been occurring within the GTA: Urban Intensification, Inner Ring Expansion, and Outer Ring Expansion. Urban Intensification areas, while somewhat located near growth centres, have been more scattered than centralized. This is primarily due to the generalizations on density within planning documents, giving municipalities little guidance on where and how to develop densities (Neptis, 2011). The Inner Ring Expansion, located on the inside border of the greenbelt, has been located almost uniformly outside the edges of the planned urban boundary. The somewhat unexpected Outer Ring growth has also occurred within and outside of the greenbelt. These developments take advantage of the existing built up areas within historic rural municipalities as far as the Township of Barrie. These outer developments have been recreating the classic effects of leapfrog development- developing where there is a lack of servicing, infrastructure, transit, and traffic accommodation. These effects worsen when considering that the densities built within the Outer Ring Growth are still the same as required by the Growth Plan at 50 Persons and Jobs per hectare. The impacts of these dense, suburban developments in municipalities which are unprepared and unregulated create a snapshot for the future challenges of outer ring growth in rural communities.

5.2 Identifying Growth Trends

Growing Suburban Regions

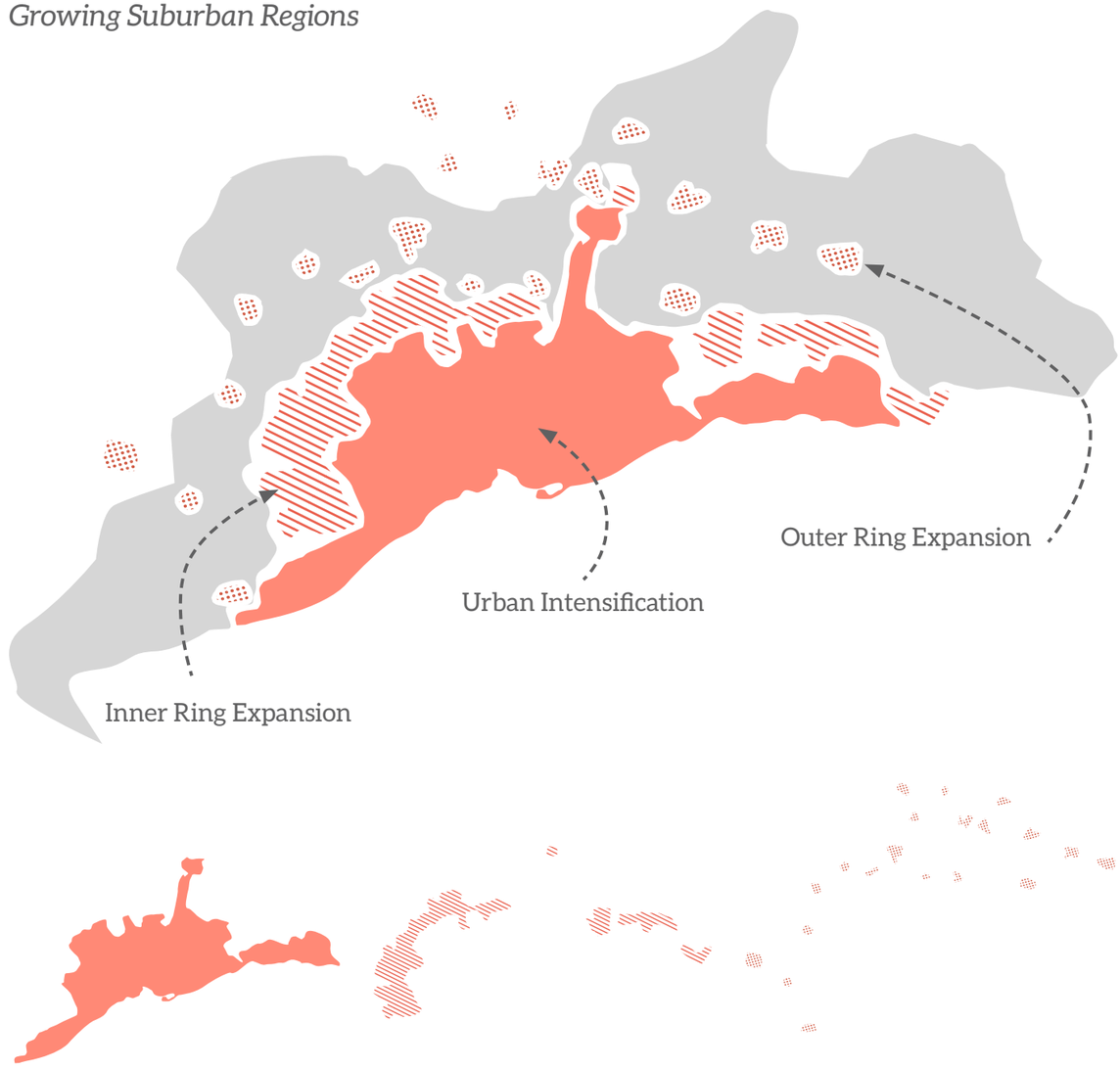


Figure 44 Growth Typologies

More classifications could have been made throughout this research, referencing previously developed classifications such as 'auto-suburbs', 'transit suburbs', 'walkable core's'. However, in this stage of analysis, the project is intended to create guidance on specific growth types while regarding their different circumstances for development. The three classifications of growth types is fitting for understanding the issues associated with the indicators and new development, as well as moving between scales to further analyse and develop them.

Figure 45 Intensification Units Growth (All Apartment Types. *Source: Census Statistics Canada 2016*

Urban Intensification

The following map reveals the areas with the highest rates of intensification. It becomes clear that the goal of Transit Oriented Densities have not necessarily occurred in the way that we would expect over the past 15 years with the development of apartment units (other than urban Toronto). One can see that the highest intensification areas are allocated along major highway interchanges. In figures on pages 68-69 one can see the results of densification on highways. Not only are these areas developed on highways, the densifying communities are often located on, or abutting mall properties, to meet the standards for 'mixed-use' amenities, and to 'meet the needs' for aging populations to have access to facilities. Further restrictions and frameworks must be enforced to ensure these communities meet the targets for transit access, walkability, multi-functionality, and reduced surface parking. Urban Intensification is a clear example of the discrepancies between the idea of sustainability, livability, and density and the reality of implementation. The analysis in later chapters will focus on these areas for the evaluation of these development typologies.

Urban Intensification

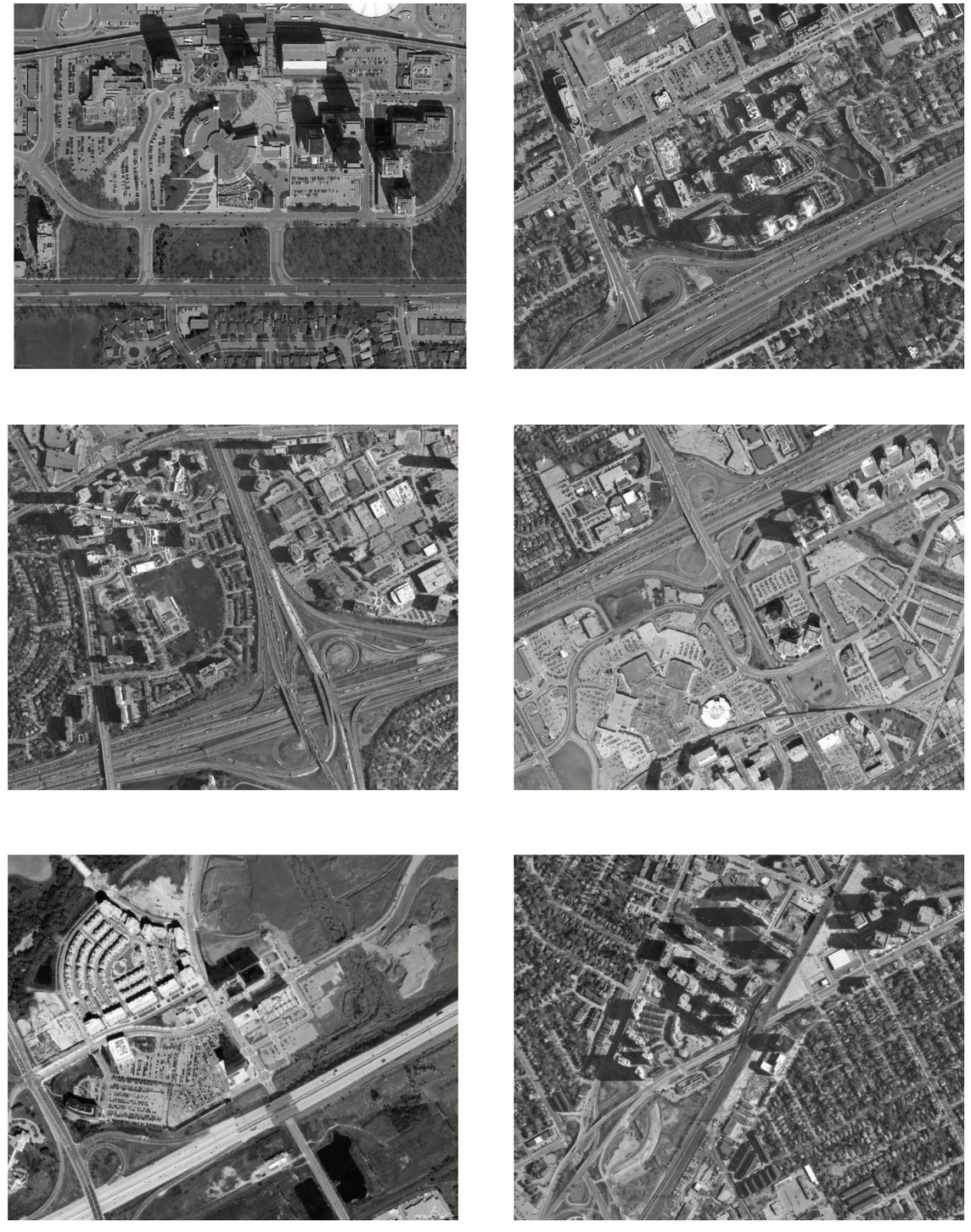


Figure 46 Urban Intensification Locations, Source: Google Earth

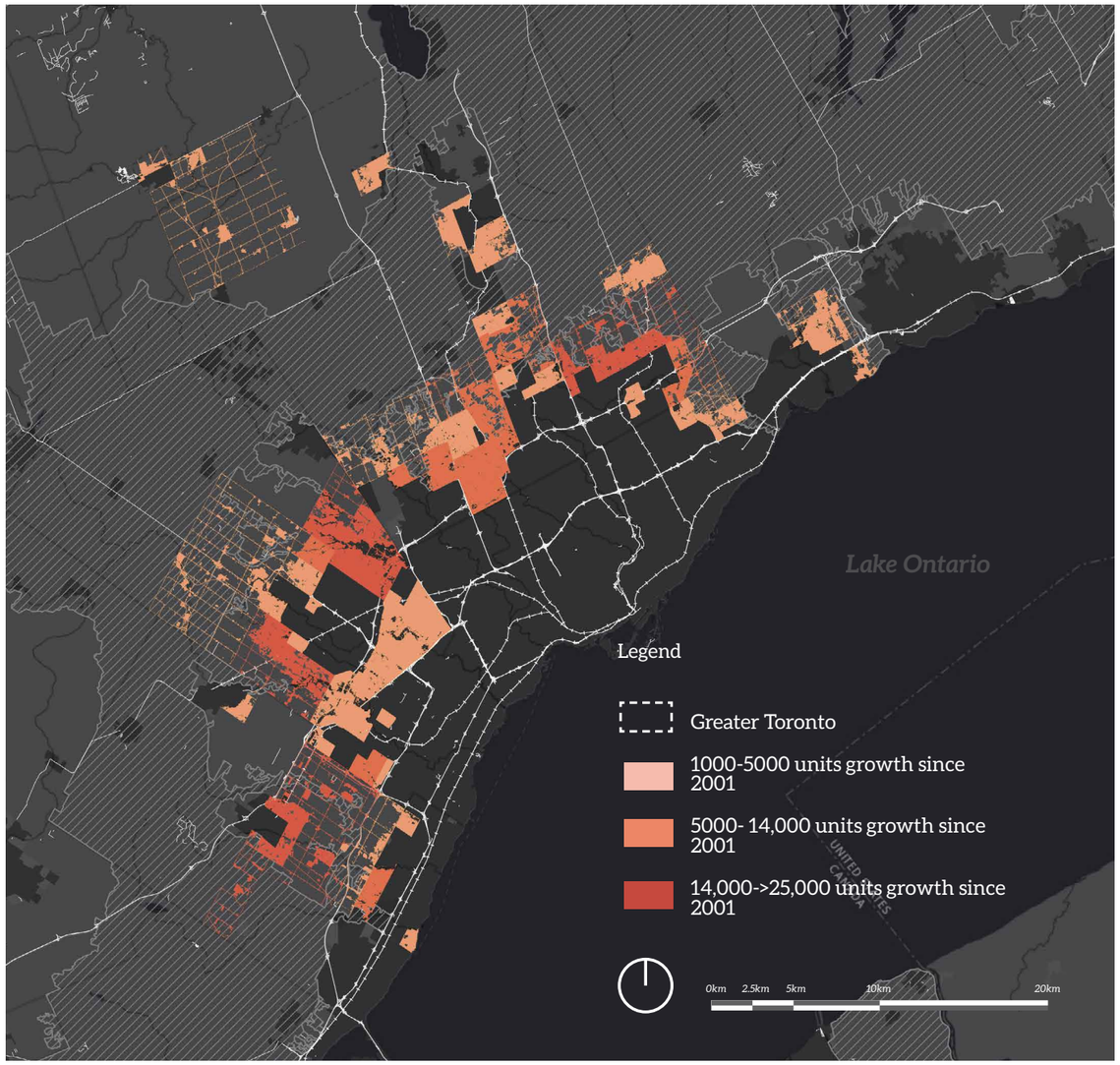


Figure 47 Expansion Units Growth (Single and Semi-Detached, and Row-housing. *Source: Census Statistics Canada 2016*

Inner Ring Expansion

The following map re-iterates the growth of greenfield developments, showing areas with the highest developments of single-detached, semi-detached, and row housing over the past 15 years. Inner Ring Expansion Areas primarily develop this low rise, mono-functional housing on existing agricultural greenfield lands. These areas are developing at a fast rate and at high densities. Though being built out at a high density, these areas are still designed similarly to traditional subdivision design with car oriented vehicular access ways, with little to no walking pathways and long development blocks preventing ease of access for pedestrians and cyclists. The analysis in later chapters will focus on these areas for the evaluation of these development typologies.

Inner Ring Expansion

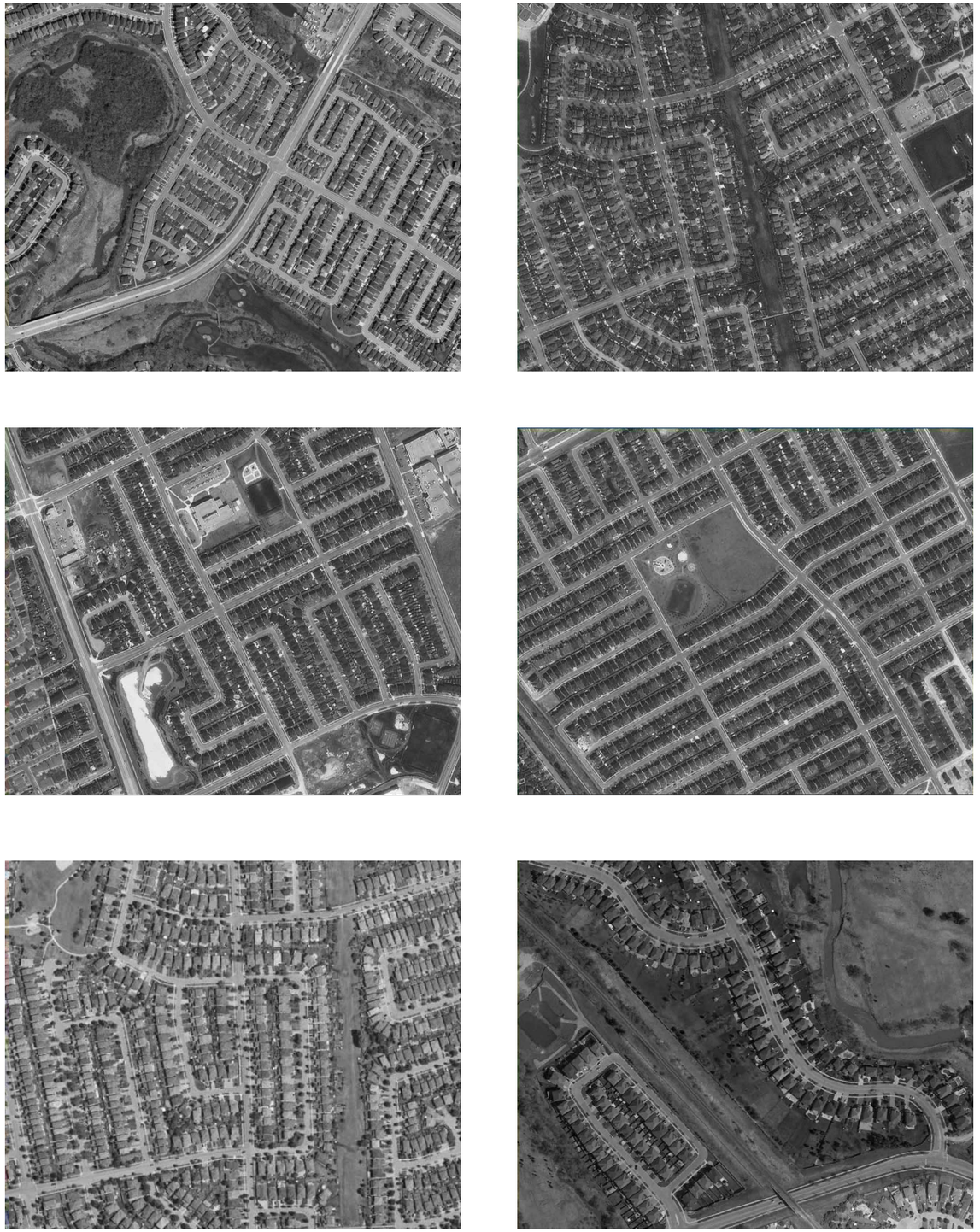


Figure 48 Inner Ring Expansion Locations, Source: Google Earth

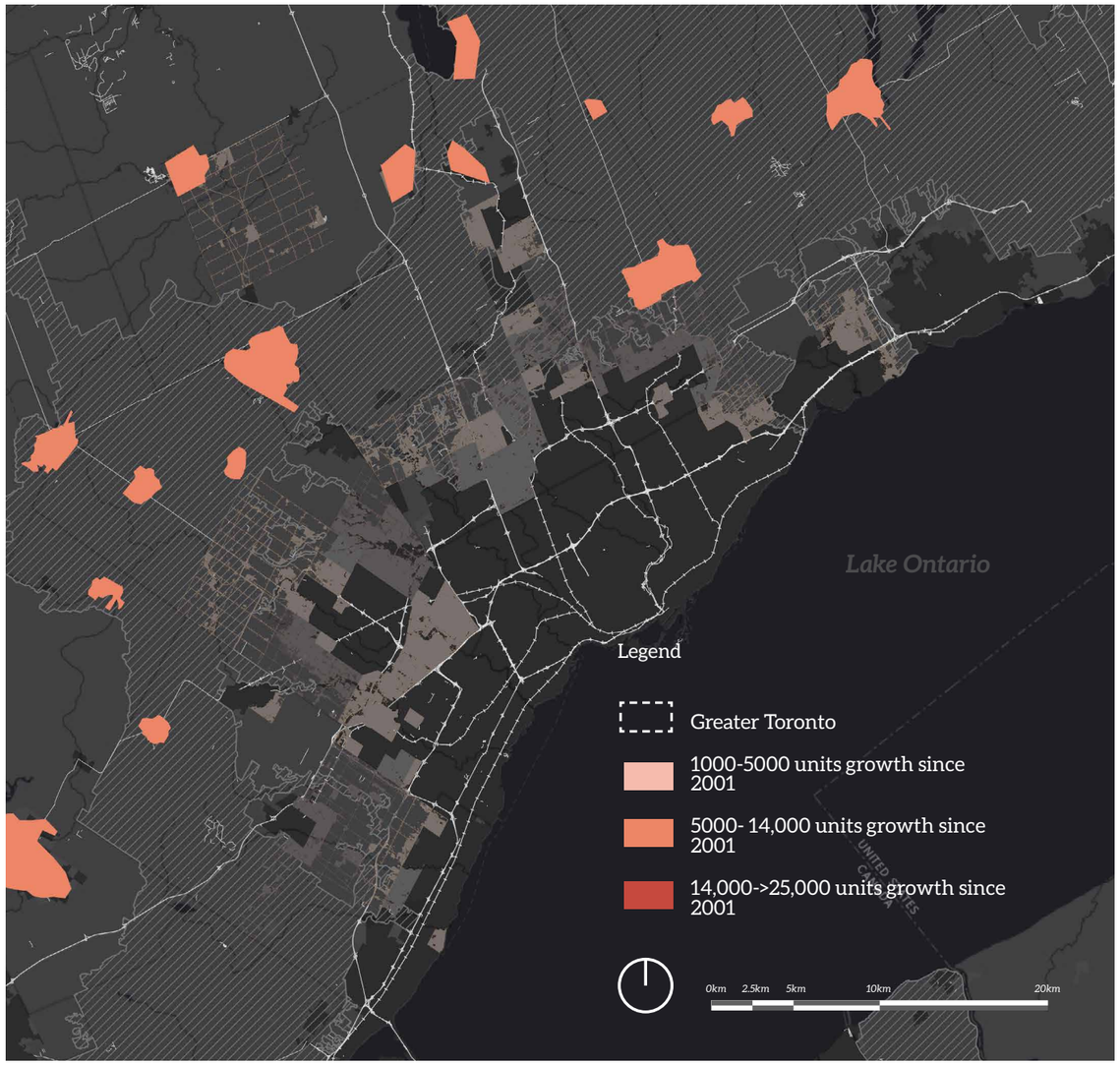


Figure 49 Expansion Units Growth (Single and Semi-Detached, and Row-housing. *Source: Census Statistics Canada 2016*

Outer Ring Expansion

The following map re-iterates the growth of greenfield developments, showing areas with the highest developments of single-detached, semi-detached, and row housing over the past 15 years within historic rural areas. While the developments themselves are quite similar to that of urban expansion, the rural towns which they belong to have quite different structures. Given that they are still small historic rural towns with a clear town centre and main street, these towns are still quite mono-centric. In many municipalities, much of the new development still has access to these city centres through walking, though the expanding new developments threaten to change this dynamic. Several of these 'satellite' towns also have primary transit in close proximity to their town core, furthering the opportunities for sustainable mobility within new growth. The analysis in later chapters will focus on these areas for the evaluation of these development typologies.

Outer Ring Expansion

Figure 50 Outer Ring Expansion Locations, Source: Google Earth

5.3 Suburban Development Patterns: Fifteen Years of Growth

Associating Patterns with Sustainability Performance Indicators

Urban Intensification, Inner Ring Expansion, and Outer Ring Expansion will be used as three growth patterns to analyse the sustainable or unsustainable practices of recent and current development within the region. These growth patterns will be reviewed with performance indicators of food, mobility, energy, ecosystem services and land use conversion, and later, quality of life. After the analysis of these typologies through mapping, diagrams, and research, the project will create conclusions for each type of growth in relation to each indicator. These will account for the issues current growth practices face and the opportunities they have available within their spatial context and limitations. Based on these conclusions strategies for potential growth patterns will be created for each growth typology. Using a small selection of these strategies, the project will develop 'What if' scenarios to explore the possibilities and realities for implementing these strategies in the GTA.

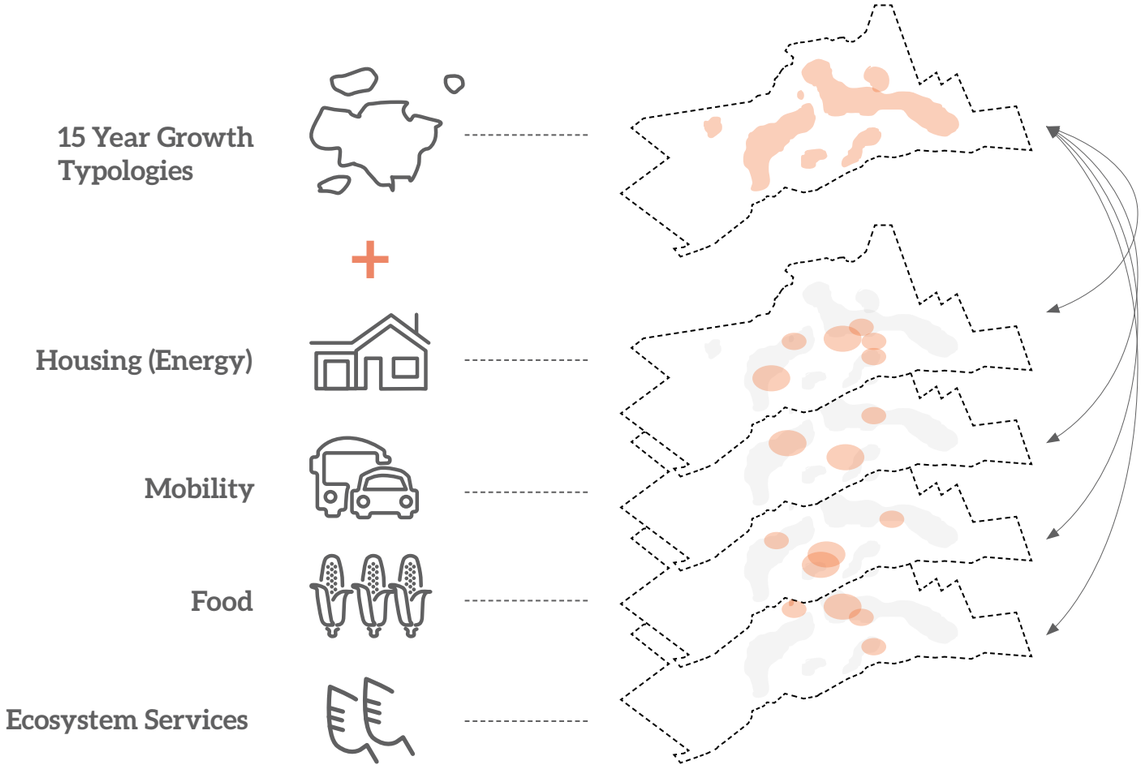


Figure 51 Indicators and Growth Diagram

Figure 52 Modular elements increase efficiency at Mackenzie Vaughan Source: Construct Connect

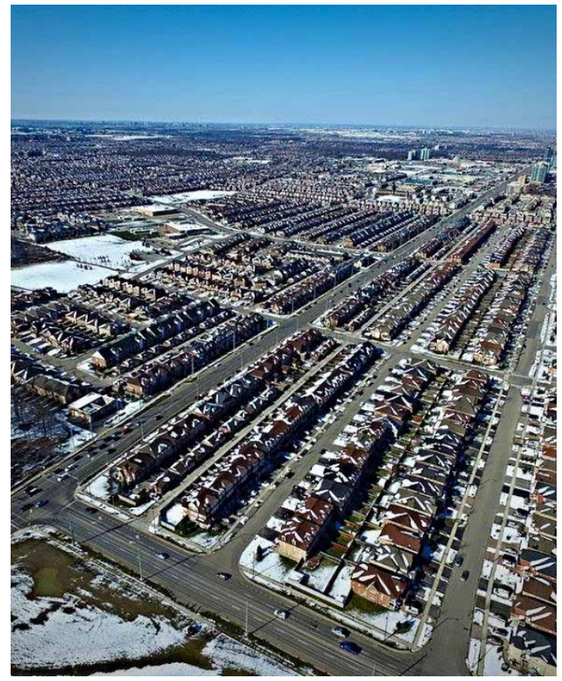


Figure 53 Suburban Area in Mississauga Toronto Source: UrbanToronto.ca

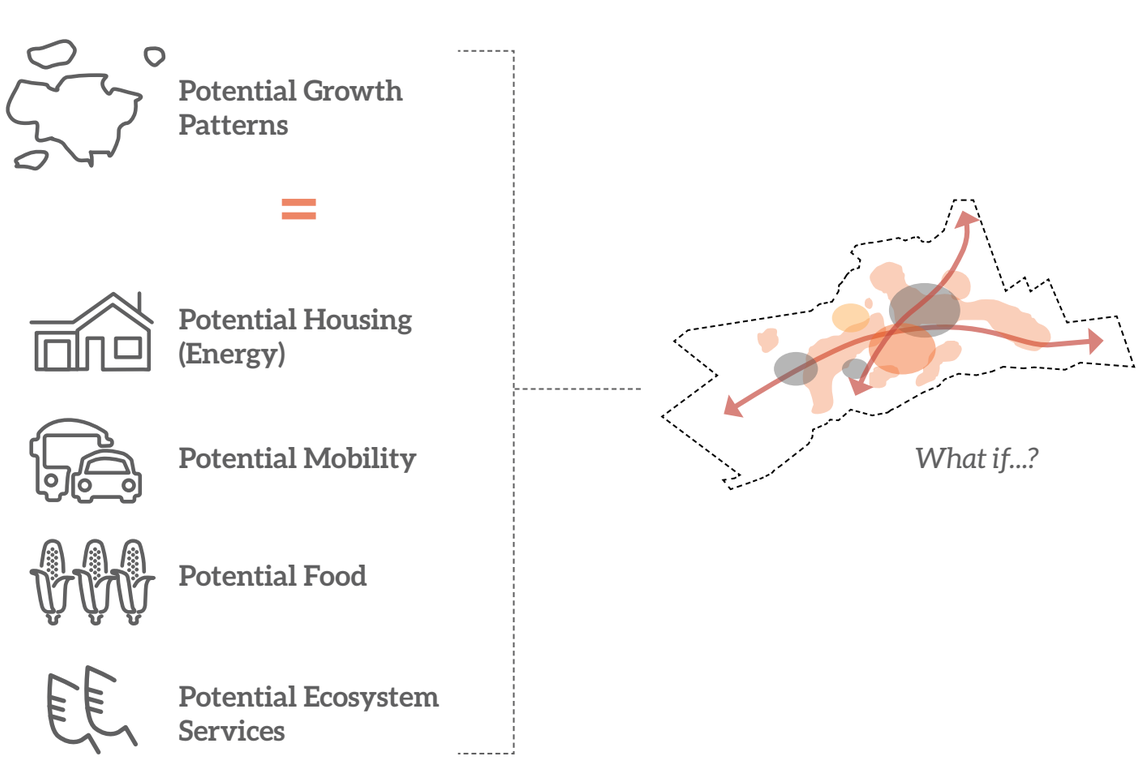


Figure 54 What if Scenario Diagram

6.0 Indicators for Sustainability

Food

As noted in the Ecological footprint analysis, Food is the highest source of a high ecological footprint in Ontario. The same can be said in many cities across the world. Food continues to become increasingly intensive as diets shift and global imports continue to dominate the market. Yet food system itself becomes difficult to shift, especially within the realm of urban planning an design. Can urban growth policies really change the way we produce process distribute and waste our food? The following analysis intends to answer this question and recognize the food system in the GTA as an indicator for sustainability within growth patterns.

6.1 The Food System Impacts:

214 million cubic metres of municipal water

10,800 tonnes of contaminants

50,600 tonnes of carbon monoxide and

29 million tonnes of carbon dioxide released into the atmosphere

1.9 million tonnes of waste

511,000 TJ of energy

Figure 55 Source: Dollars & Sense Opportunities to Strengthen Southern Ontario's Food System

The Food System in Ontario

While the current planning discourse frames the agricultural system as a dwindling economy, the Ontario food system is a significant part of the Provincial economy (Econometric Research Limited, Harry Cummings & Associates Rod MacRae, 2015). Ontario's food system creates a revenue of $63 billion and employs more than 767,000 people (Econometric Research Limited, Harry Cummings & Associates Rod MacRae, 2015). This includes the system of production, processing, and distribution. Yet the current food system still struggles to remediate its environmental impacts which it has on the regional and international scale. These includes a high water demand, air emissions, pollutants, energy demands, greenhouse gases, solid wastes, contaminants and green GDP (Econometric Research Limited, Harry Cummings & Associates Rod MacRae, 2015). This also includes a high amount of import foods from other countries globally. According to the Dollars & Sense Report (2015), Ontarians are consuming more food than the province produces, resulting in food imports that exceed $20 billion per year. Over 50% of this imported food can actually be produced within the province. These small ironies and infinite possibilities for the food system exist within a future framework for the Ontario food system. Growth planning can capture a small part of these opportunities by managing urban expansion, the quality of agricultural lands, and incentivising local production in new development areas.

These changes in growth are not simple. Though there is much discussion about agricultural land preservation in urban planning, there is often not a relative understanding of the state of agriculture, the practice of farming, and the true impacts that affect farmer's livability (BUNCE & MAURER, 2005). It is not the intent of the report to glaze over the complex system that is agricultural systems and land systems, but attempt to understand how the current trends and patterns are making agricultural processes more or less sustainable in producing local food, cash crops, or livestock. This report intends not to only look at the system as an industry but also through the lens of farmers in the GTA who, in the end, must possess the right to decide the future of their land. The following sections include a spatial analysis of the processes researched in the food system throughout this research project.

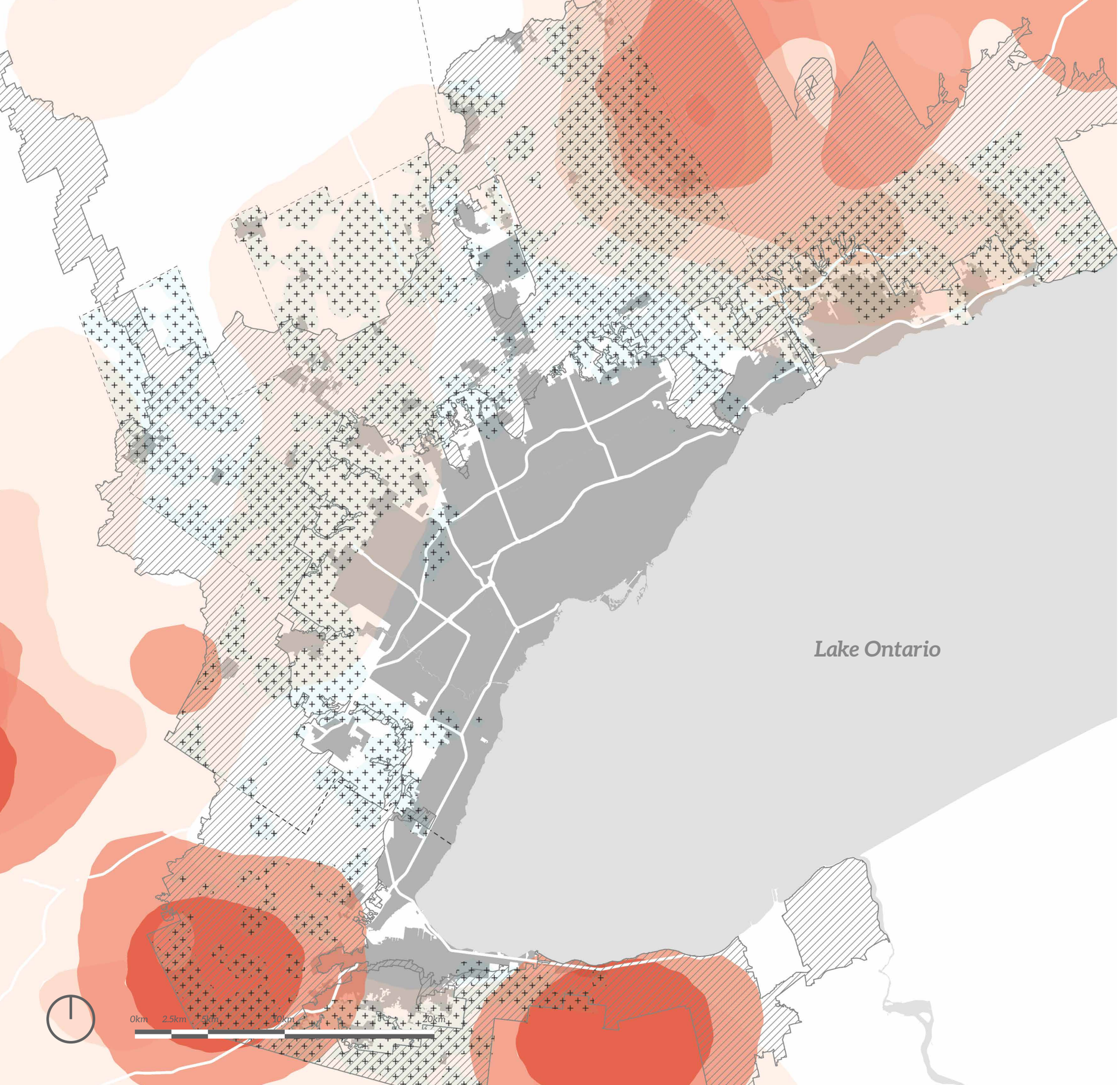
Food Production

The following map indicates the production of Produce/Grains, and Meat production in the GTA. As can be seen within the map, meat production is located further away from the built boundary in areas which fall outside of the greenbelt. The Produce/Grain production is located within the greenbelt and moving outwards. As it currently stands there is little official food production in the GTA. Further analysis needs to be provided in order to analyse the production capacity for the built area of the GTA.

As the land cover data reveals, the urban built boundary does not provide a significant amount of agricultural lands for production. On one hand, the means growth in the urban area does not convert agricultural land, on the other, it is clear that more must be done to integrate agricultural practices in the area on a smaller scale.

Inner Ring Expansion infamously develops agricultural lands in the process of growth. This conversion reduced the amounts of local production.

Similar to the Inner Ring, ORE expands into agricultural production with growth. The difference remains that many of these areas are located within the greenbelt plan. Regardless, these municipalities continue to expand into their rural lands, disrupting the rural economy which is at the core of these towns.



Legend

- Greater Toronto
- Grains and Vegetable/Fruit Production
- Low Density Meat Production
- High Density Meat Production

Figure 56 Food Production. *Source: Census Canada 2016, OMAFRA Agricultural Database & Canada Land Cover Data 2017*

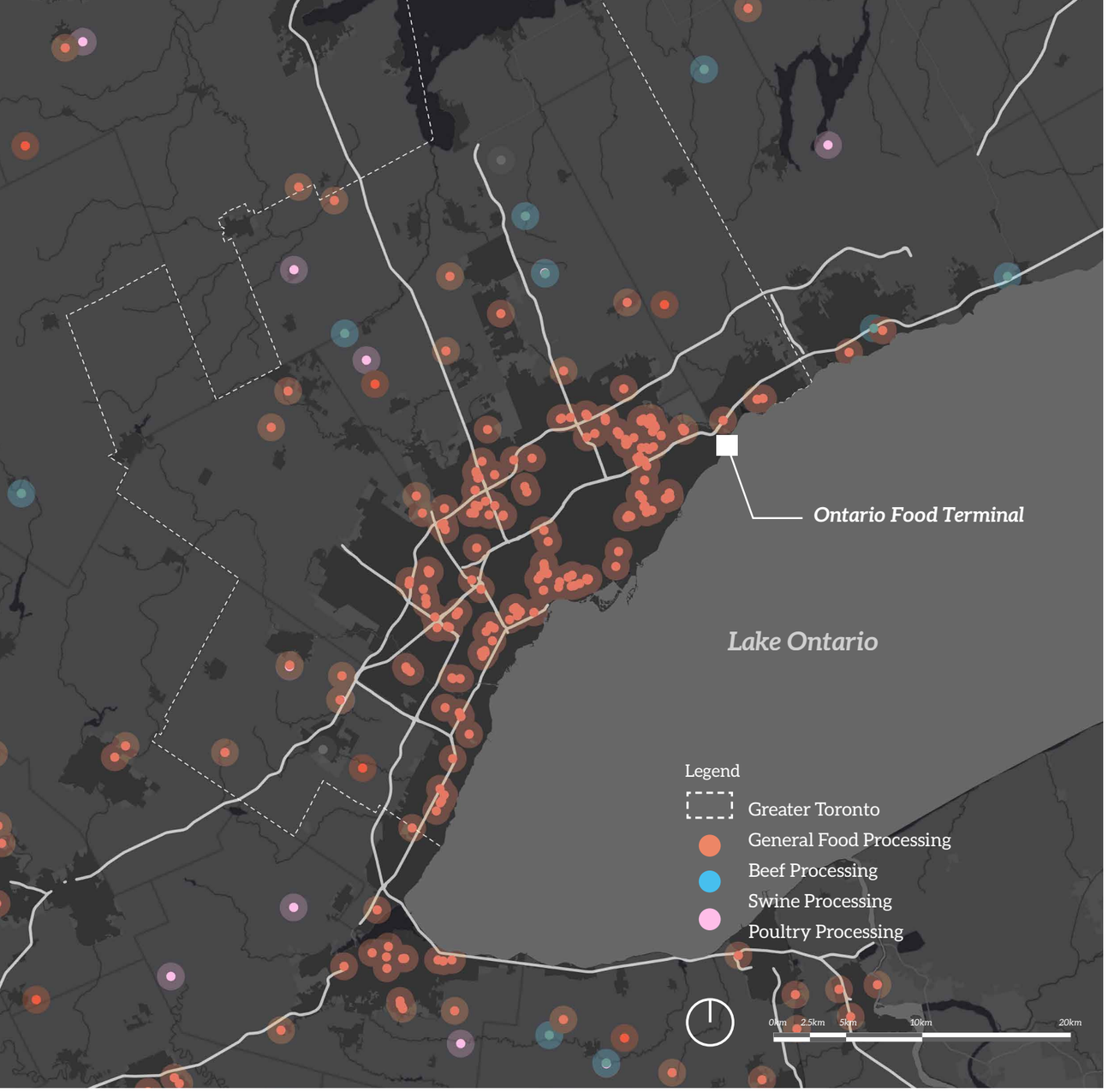


Figure 57 Food Processing. *Source: OMAFRA Argricultural Data*

Food Processing

The following map provides the locations of food processing plants. Similarly to the food production the produce is processed close or within the built area whereas meat production is in the periphery closer to the production. Within **urban intensification** areas, general food processing plants surround the industrial rings. These industrial areas are often use for redevelopment land within the existing built boundary. As these areas are used for redevelopment, the relationship between industrial food processing and residential/mixed use areas has the potential to shift. Within the **inner ring expansion** area there is a lower density of all types of processing, this is most likely due to the monotonous residential and commercial developments occupying these areas which have less industrial land use coverage. Within the **outer expansion** areas there is a larger mix of food processing due to the closer proximity to farmland within the rural communities. This provides an opportunity for future growth in these areas. A closer link between processing and core distribution creates an opportunity to increase local food intake and reduce the amount of transportation of local foods.

Food Processing

According to the Dollars & Sense Report (2015), Ontarians are consuming more food than the province produces, resulting in food imports that exceed $20 billion per year. Over 50% of this imported food can actually be produced within the province. In order to become more self-sustainable, the province has the opportunity to produce food demands locally. This could generate more jobs, economic activity and reduce the amount of transport needed to ship food from outside the province unnecessarily.

Exports Total	$ in Millions
Live animals	315.9
Red meats	1131.0
Fish and products	122.7
Poultry and eggs	257.9
Dairy products	141.1
Other animal products	581.6
Grains	556.8
Grain products	3417.5
Oilseeds	1073.4
Oilseed products	434.6
Animal feeds	525.1
Fruit and nuts	236.0
Vegetables	1700.3
Seeds for sowing	109.8
Vegetable fibres	0.7
Floriculture and nursery products	316.5
Tropical products (excl. fruit)	652.5
Sugar and confectionery	1031.5
Other edible preparations	1167.0
Beverages	573.2
Tobacco and products	206.8
Other agri-food products	377.8
TOTAL	14,930

Imports Total	$ in Millions
Live animals	126.4
Red meats	2091.6
Fish and products	1174.4
Poultry and eggs	695.0
Dairy products	511.4
Other animal products	248.5
Grains	326.3
Grain products	2626.4
Oilseeds	367.8
Oilseed products	633.1
Animal feeds	981.2
Fruit and nuts	4245.0
Vegetables	3127.2
Seeds for sowing	428.8
Vegetable fibres	19.6
Floriculture and nursery products	292.4
Tropical products (excl. fruit)	1902.4
Sugar and confectionery	1444.2
Other edible preparations	2999.3
Beverages	2309.2
Tobacco and products	83.9
Other agri-food products	696.4
TOTAL	27,330

Figure 58 Food Processing. *Source: OMAFRA Agricultural Data*

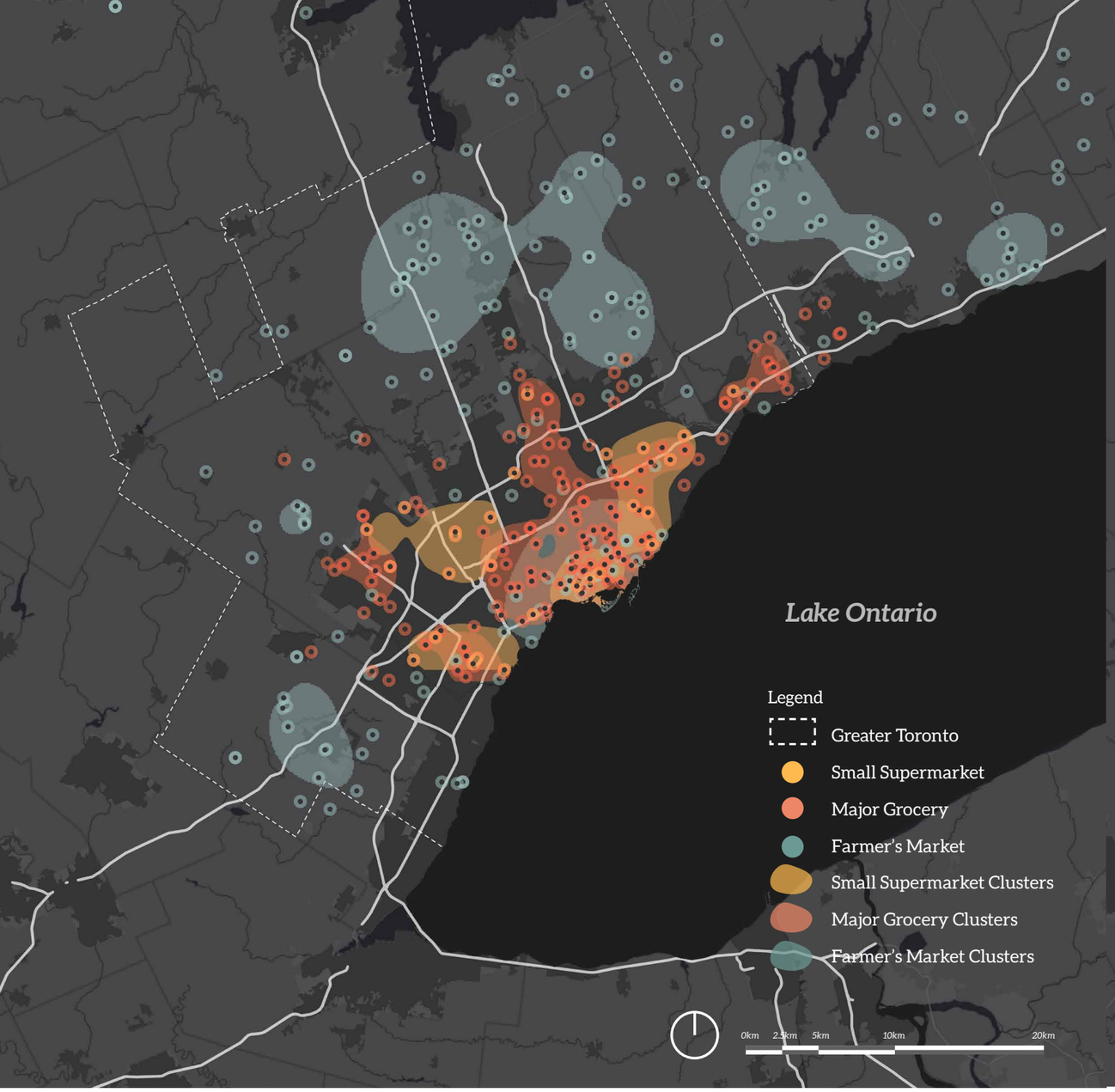


Figure 59 Food Distribution. *Source: Yellow Pages & OSM Data*

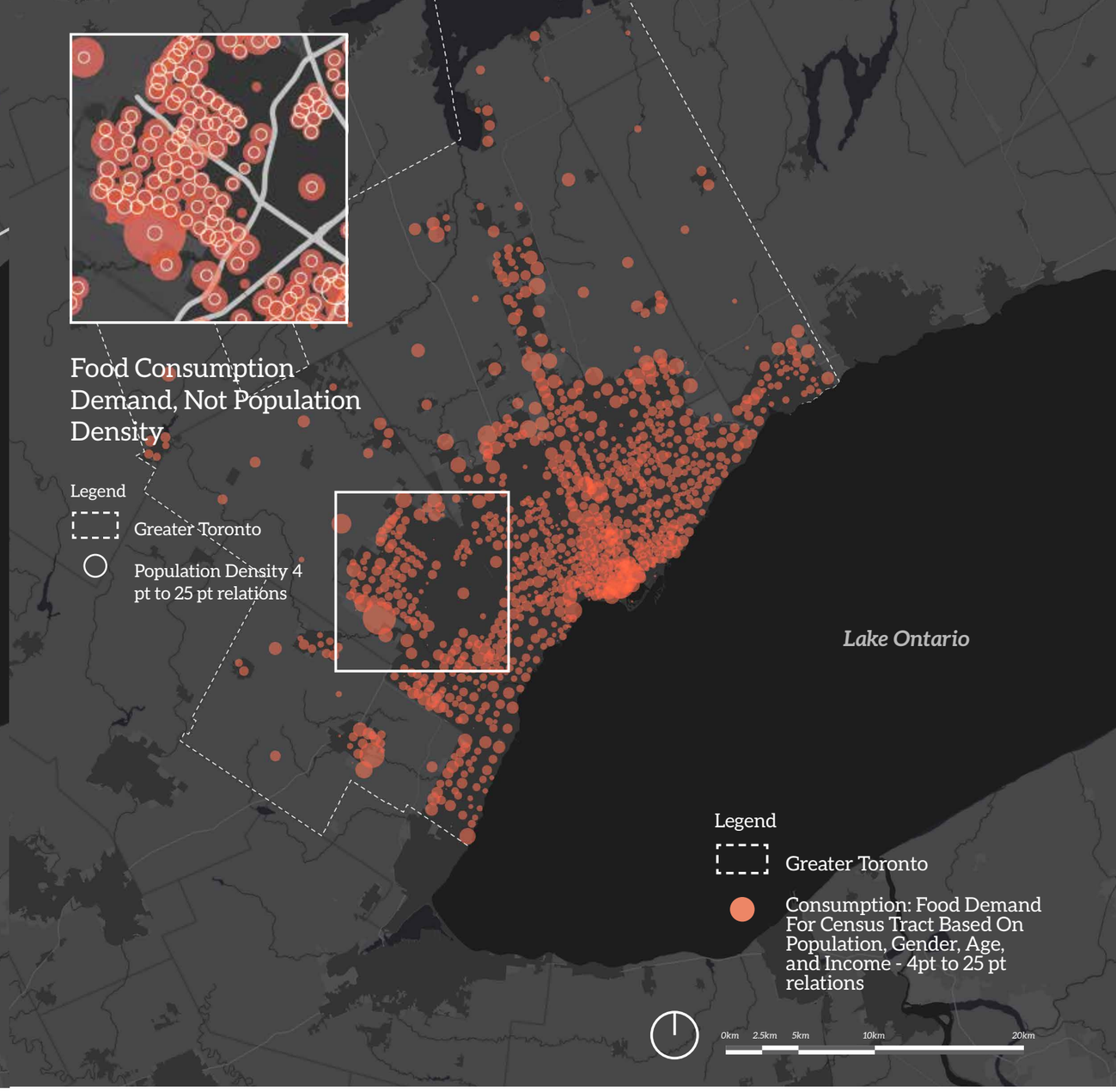


Figure 60 Food Consumption Demand Estimate. *Source: Census Canada 2016*

Food Distribution

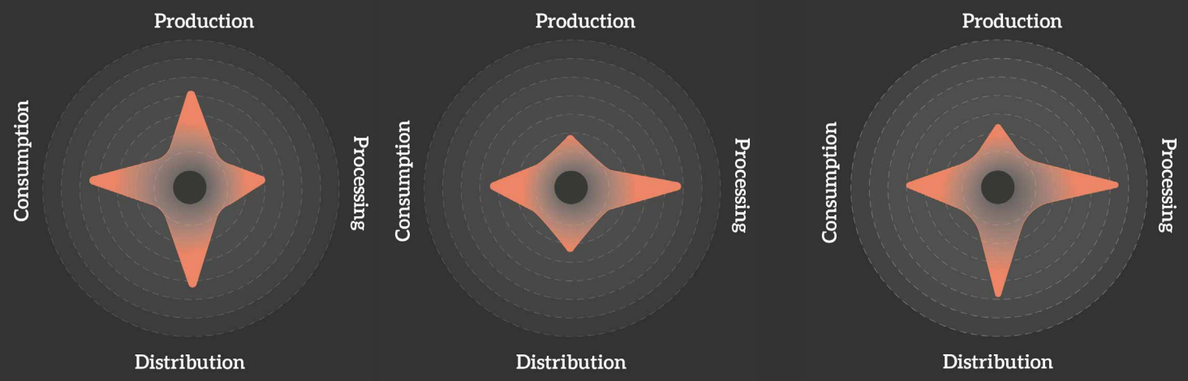
Food is distributed through multiple centres, but the main facilities are super markets, grocery stores, and farmers markets. The highest densities of these centres are located in the urban downtown of Toronto. The farmer's markets are located more in the periphery. The difference between the three growth patterns can be easily identified when looking at the density of food stores and types. As one can see, there is a larger density and mix of food distribution within the **urban intensification** zones. Moving outwards there is a larger amount of major grocery stores. Within the outer ring expansion areas, there are more farmers markets than anywhere else in the region. Small markets and Farmer's Markets general stimulate more opportunities for selling local food from the production around the city, major grocery stores often have import contracts with global suppliers, making it difficult for local farmers to sell their seasonal produce to these chains.

Food Consumption

The food consumption map was created from census data, The Ontario household spending survey, a survey conducted within Veeramani (2015). The data used population, gender, age, and income to develop results. One can see that the food demand within the urban intensification areas are significantly lower that those in the inner and outer expansion areas on average. While this is more likely due to population discrepancies, the consumption map shows us that demand is moving and expanding outwards into the Inner Ring Expansion Areas. As seen in the food distribution map (figure 72), these areas have less access to food stores in walking proximity, in fact most of these areas do not have a food distribution centre within a 30 minute walk. Therefore, areas with higher food demand are located in auto-oriented neighbourhoods with larger box stores which have less tendency to market local products.

6.2 Conclusions on Food and Growth Typologies

Food Performance Indicators Findings: Issues



Urban Intensification

Production: Urban Intensification generally takes place in areas which are currently 'built up' areas. Due to the existing density targets, and price of land, the ability to integrate open spaces for food production becomes difficult.

Processing: The processing which occurs near urban intensification is currently that of vegetable and grain processing in industrial areas. These industrial areas within the GTA are often targeted for redevelopment. It is vital that this redevelopment is not displacing food processing and other light industry in the GTA.

Distribution: Urban intensification has the ability to create easier access to grocery stores and has the highest access to grocery stores given the density and ability to create mixed use areas. However, integrating grocery stores which provide locally produced food will prove to be more difficult as the development in the suburban centres are dominated by large scale grocery businesses. As previously stated, the current development style of these areas are still promoting vehicular use, meaning that residents who may be in physical walking distance to grocery stores may still drive.

Consumption: Based on the indicators analysis consumption was the lowest in urban intensification areas. Though, this is most likely due to the young adult population which inhabits these areas. When incorporating a larger mix of housing these rate would seemingly become more balanced. The focus must not only be to limit consumption, but to also provide local foods to consume.

Inner Ring Expansion

Production: The Inner Ring still contains a large amount of high-quality farmland in the GTA. Yet, these are the lands which are being expanded into with Inner Ring development. This farmland is barely integrated into development or strategically conserved based on crop type. Though the province states that it's goal is to preserve this farmland, farmers must always have a right to sell their land, as it is often a source of income and savings which is necessary after a lifetime of farming. This key issue which lies outside of land use planning. Preserving farmland is more affective when economic incentives are given to farmers to allow them to continue their practice.

Processing: Most processing plants are located closer to the urban industrial areas more central in the region.

Distribution: Inner Ring Expansion generally consists of mono-functional residential and commercial areas. The commercial areas contain larger box stores. The same is true for grocery stores where large companies dominate the market. These stores are less likely to integrate local food, as they have contracts with global distributors which rely heavily on food imports. Most stores are accessed by car which creates large swaths of parking around the stores. This makes walking even more difficult.

Consumption: Based on the indicators analysis consumption was the highest in inner ring expansion. This due to higher incomes, an expanding density in new areas, and of course the age of inhabitants.

Outer Ring Expansion

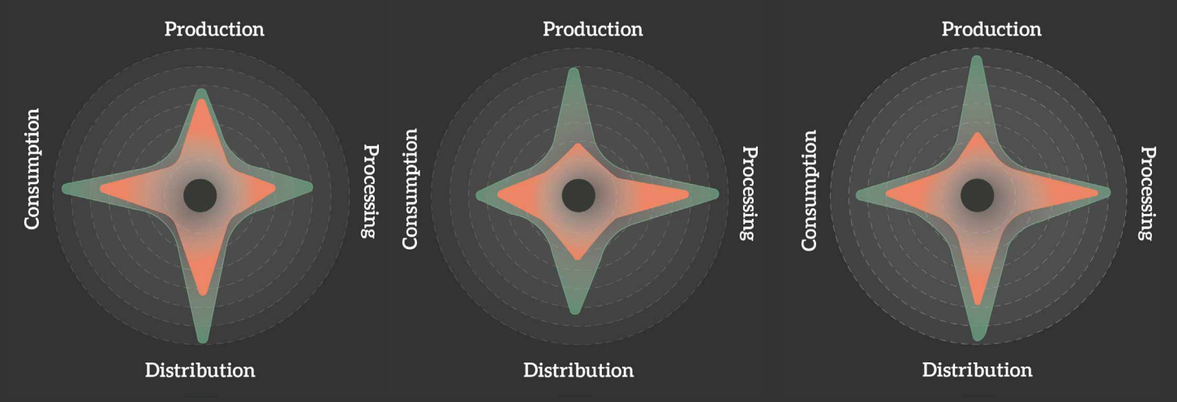
Production: Outer Ring Expansion areas are generally surrounded by large swaths of farmland. These towns are a within conservation areas of the greenbelt or further from the city which has previously forbeid development. Yet, the out rings are now growing at a faster rate, consuming these lands.

Processing: A large mixture of processing occurs near these areas, as they are located further away from the large urban boundary.

Distribution: Outer Ring Expansion have begun to introduce more box stores which have and will create less incentives for the existing farmers markets and local groceries which already exist in small rural towns.

Consumption: Based on the indicators analysis consumption was the highest in these regions due to a higher age population and income.

Food Performance Indicators Findings: Opportunities



Urban Intensification

Production: Though Urban Intensification typologies generally have less space, there is still room for small scale community oriented food production. These can occur on roof spaces and infrastructural buffer lands, such as rail and hydro corridors. Though these processes will be of a lesser scale, urban intensification will no be lessening the agricultural land in the GTA, meaning increasing agricultural land will only add to the production of local food, no matter the scale. To add, the climate in the winter months puts a hold to outdoor food production. Urban intensification offers opportunities for winterized green houses and interior production on rooftops.

Processing: The processing which occurs near urban intensification is currently that of vegetable and grain processing in industrial areas. To avoid the redevelopment and eradication of space for food processing plants, it is vital to adapt to multi-functional develop, preserving light industrial uses ingrained into new urban areas.

Distribution: While Urban Intensification currently has the highest access to food out of the typologies, it is still important to ease access to food by creating truly walkable connections. These locations should not only be walkable, but also provide smaller scale local food sellers in urban areas using community initiatives and incentives.

Consumption: The focus of consumption in the realm of urban planning should be having access to affordable and local food in order to lower ecological footprint. In order to improve the issue of consumption and waste, there must be education programs and incentives for consuming less and wasting less food.

Inner Ring Expansion

Production: The Inner Ring contains development which will take place on high-quality farmland. There is an opportunity to integrate this farmland into developments in order for farmers to rent the remaining land to increase their land mass. Land renting after a developer buys land is already a common process in the GTA. These lands have the opportunity to continue producing local demand foods in the region, with less of a travel distance to local stores.

Processing: Most processing plants are located closer to the urban industrial areas more central in the region.

Distribution: Inner Ring Expansion has the opportunity to change the way which people access food. This can be done with targeted building density and mixed use communities which provide walkable access to grocery stores.

Consumption: Based on the indicators analysis consumption was the highest in inner ring expansion. This due to higher incomes, an expanding density in new areas, and of course the age of inhabitants. The focus of consumption in the realm of urban planning should be having access to affordable and local food in order to lower ecological footprint. In order to improve the issue of consumption and waste, there must be education programs and incentives for consuming less and wasting less food.

Outer Ring Expansion

Production: Outer Ring Expansion areas are generally surrounded by large swaths of farmland. The growth in the outer ring is slow enough to accommodate within the existing built boundary. This could allow for the preservation of farmland. If the farmers in the adjacent lands wish to sell their land, it is possible that it be sold to energy providers which could use the land for wind power and biogas production while renting back the remaining land to farmers.

Processing: A large mixture of processing occurs within the industrial areas of these towns themselves. These areas employ a large amount of the population. This creates a short distance from these areas to the city centre. Waste from these processing plants could be used for other additional uses such as biogas or compost.

Distribution: These towns have historically been rural communities with a strong sense of agricultural production and distribution. As one can see the distribution map, these towns have the highest amounts of farmers markets. This should be seen as an opportunity to harness these food hubs and food relations with farm and non-farm populations.

Consumption: Based on the indicators analysis consumption was the highest in these regions due to a higher age population and income. Yet, the suggested consumption of local foods offer an opportunity to harness local production consumption relationships.

Mobility

Simply put, the GTA is a region built around vehicular transportation. The proof is in the numbers – personal vehicles account for an astonishing 21% of total CO2 emissions in the GTA, with commercial vehicles accounting for 11.8% (Boston Group, 2008). In fact, ground transport accounts for more CO2 emissions than electricity or natural gas consumption (Boston Group, 2008). We know that more trips and longer travel distances by car/truck generate more CO2 emissions and indicate room for improvement in sustainability.

Travel and CO_2 Emissions

There are two main factors that increase travel; population and employment growth. From 2006-2016, the GTA experienced a population growth rate and employment growth rate of 0.8% and 1.3% respectively (Metrolinx, 2018). When there are more people and more people going to work, the total distance traveled in the GTA increases, and with it, total CO_2 emissions. In this car-rich area in 2016, 84% of households owned at least 1 car, with 44.3% of households owning 2 or more. People rely on their cars to get places because of the lack of public transport, cycling or walking infrastructure. This also results in more massive parking lots that take up precious space in the urban centres that could be used for more sustainable density.

Commuting

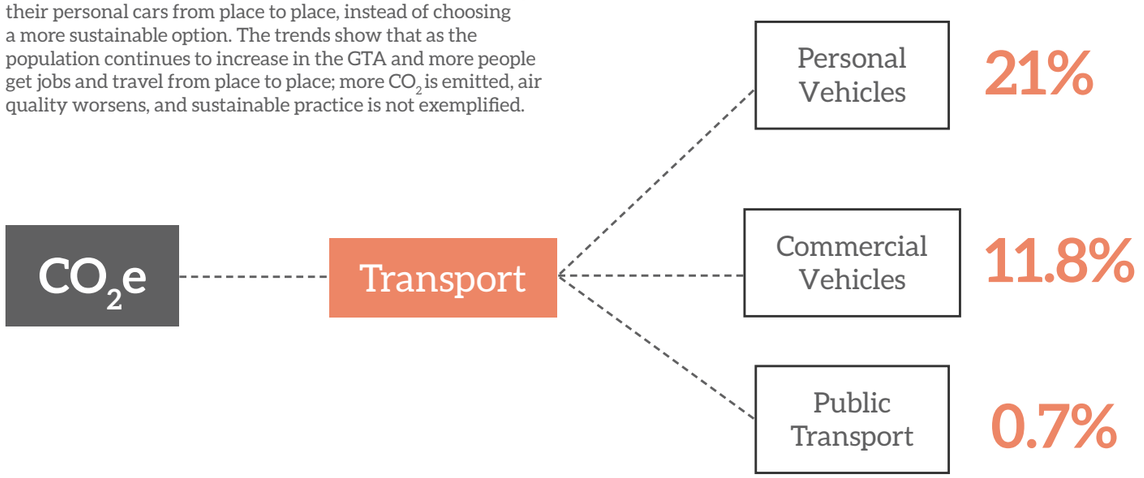
The 2041 Regional Transportation Plan for the Greater Toronto and Hamilton Area clearly states that "It is often difficult to undertake…travel spanning municipalities on transit, due to the disjointed nature of transit across municipal boundaries" (Metrolinx, 2018). This means that anyone who must work or travel from one city to another, has a hard time doing so on public transportation and usually reverts to driving. Any public transportation travel into downtown Toronto is by the TTC or Go bus or rail, while internally within cities, walking, cycling or local transit is prominent. The number of people/trips into Toronto from outside Toronto is astonishing – almost 2,000,000 trips occur each day from outside the Toronto boundary, into it (Metrolinx, 2018). Additionally, 25.1% of the population commutes for work from outside to the Toronto boundary, into it (Metrolinx, 2018). What is most interesting, however, is the mode of transportation by which these trips are travelled. When people are commuting from outside Toronto to downtown Toronto, 30.7% of trips are by car and 69% by transport (Metrolinx, 2018). In contrast, for people traveling outside Toronto to other parts of Toronto (not downtown), 89.5% are by car and only 9.6% is by transit (Metrolinx, 2018). Humans tend to make these travel decisions based on convenience – when a trip is cheaper, faster or more convenient by car, why would they choose any other mode of transport? How can the region make these options more affordable?

These mobility trends are a clear indicator of sustainability in the GTA. We see an astonishing amount of people driving their personal cars from place to place, instead of choosing a more sustainable option. The trends show that as the population continues to increase in the GTA and more people get jobs and travel from place to place; more CO_2 is emitted, air quality worsens, and sustainable practice is not exemplified.

21% of CO_2 Output in the GTA is caused by personal vehicular travel

84% of households own 1 car or more in the GTA as a whole

45% of households own 2 car or more in the GTA as a whole



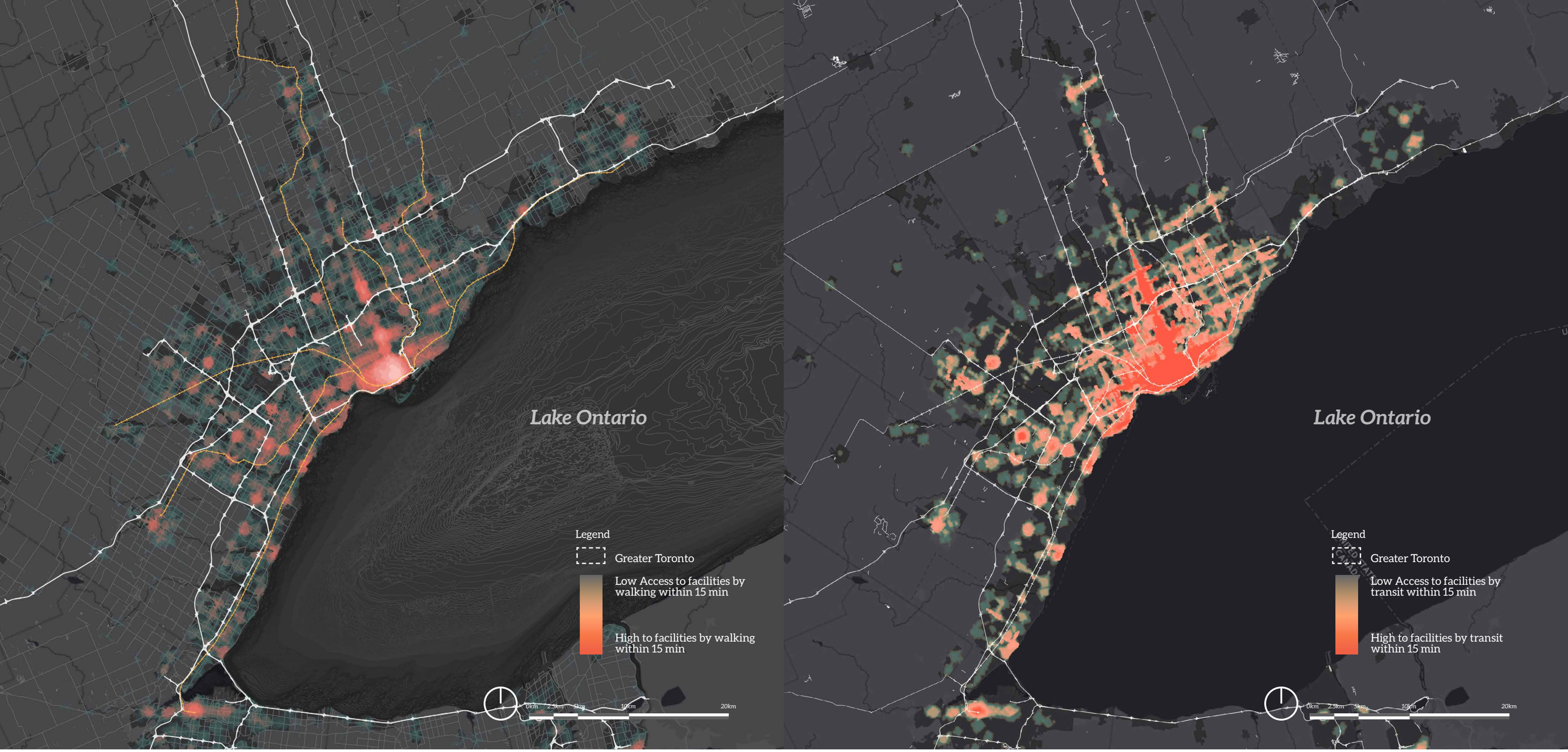


Figure 61 Access to facilities through walking *Source: Scholars Geoportal & Yellow Pages*

Accessibility to Facilities by Walking

The following is an analysis on the access to facilities that one has from walking with a 15 minute buffer based on a network analysis. The following map considers facilities as:

Amenities
- Shopping Centres
- Shopping General
- Grocery Stores
- Farmers Markets
- Pharmacies

Points of Interest
- Community Centres
- Hospitals
- Medical Centres
- University + Colleges
- Primary and Secondary Schools
- Sports Facilities
- Central Employment Districts

Part of the issues associated with suburban street design is a lack of permeability for pedestrians and far reaching facilities. What is more unexpected, is the lack of walkable areas located within the intensification centres.

Accessibility to Facilities with Transit

The following is a multi-modal analysis based on the current street network for walking and transit using a GTFS enabled network dataset.

Amenities
- Shopping Centres
- Shopping General
- Grocery Stores
- Farmers Markets
- Pharmacies

Points of Interest
- Community Centres
- Hospitals
- Medical Centres
- University + Colleges
- Primary and Secondary Schools
- Sports Facilities
- Central Employment Districts

Accessibility to Trips per Hour

The following map represents the amount of transit stops that are available within a 15 minute walk, but more importantly, the score values are based on the number to trips per hour of the given stations. This map reveals the discrepancies between the different transit authorities. While their is a regional transit planning body (Metrolinx), 7 different private/public companies manage different transit networks in each region. This has created disconnected and inefficient transit lines, which are no representative of the population which they are serving.

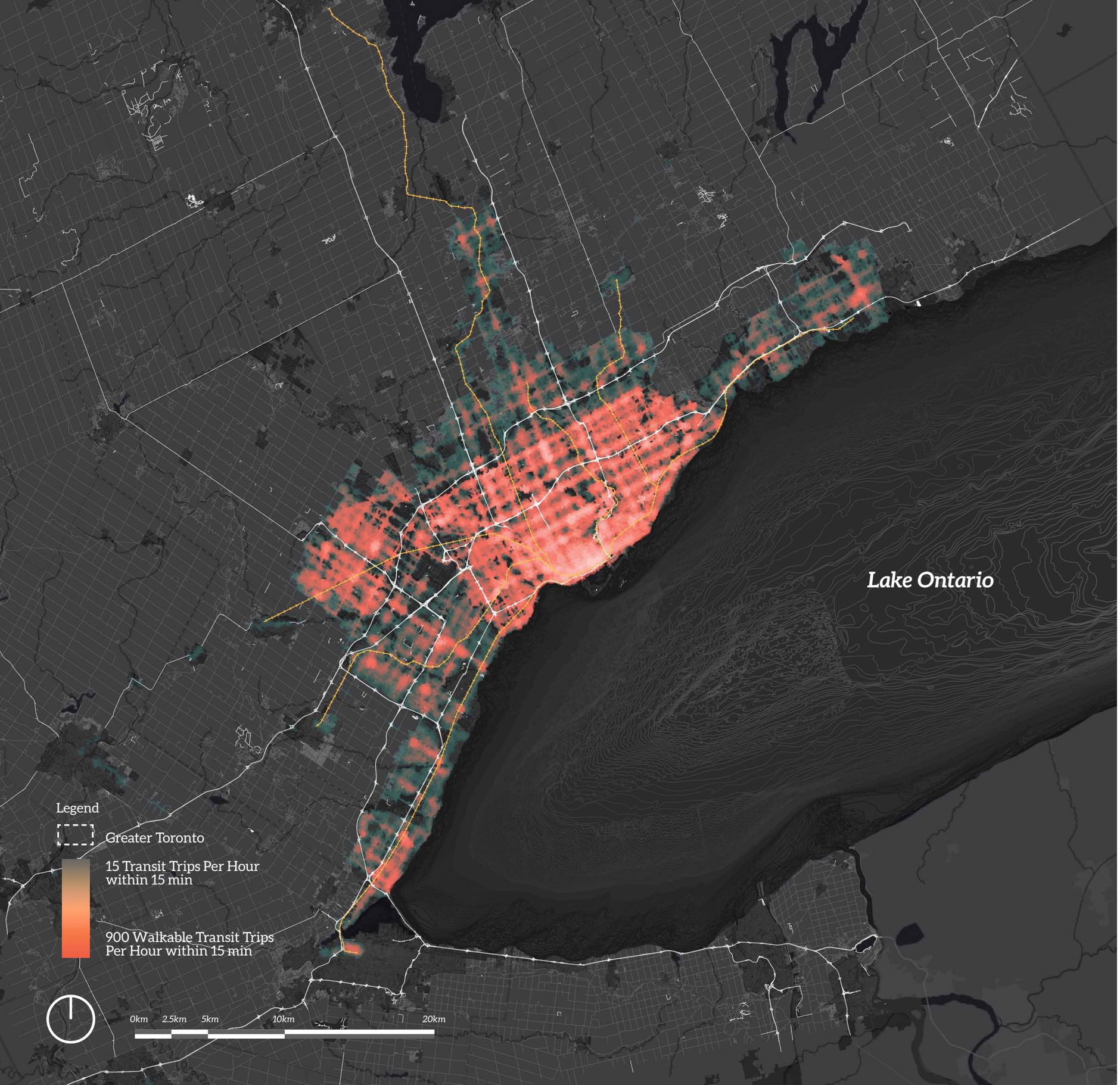
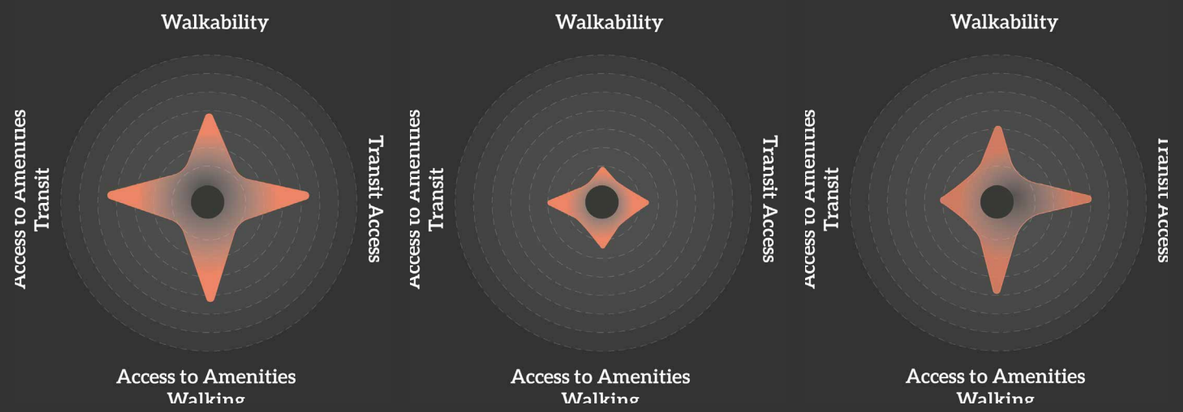


Figure 62 Access to Number of Stations. *Source: Scholars Geoportal & Yellow Pages*

6.3 Conclusions on Mobility and Growth Typologies

Mobility Performance Indicators Findings: Issues



Urban Intensification

Walkability & Automobile Oriented Design : In terms of walkability, this study focused on access to amenities, services, shops, education, and parks. The study also looked at the connectivity of the street network in design of neighbourhoods. Urban Intensification generally takes place in areas which currently have access to services. These services are generally provided by the abutting malls and box stores located in close proximity to growth. Though this creates higher access than other growth types, the actual walkability of these areas are not necessarily high. Most areas are abutting large highways on one side, and on the other large connector roads surrounded by parking. This has created a high ownership of cars, even in apartment living.

Transit Access: These areas have provided the highest transit access, but are still lacking comparatively to its more central counterparts. Creating density and intensification areas next to GO train stations has been extremely lacking in the development of inner growth and the Provincial Growth Centres.

Access to Amenities by Walking: Urban intensification has the highest access to amenities. Yet these amenities are rarely mixed use and still mono-functional at a large scale.

Access to Amenities by Transit: Urban intensification has the highest access to amenities through transit. Yet these amenities are rarely mixed use and still mono-functional at a large scale.

Inner Ring Expansion

Walkability & Automobile Oriented Design: Most of all Inner Ring Expansion and Greenfield development uses subdivision design at recently high densities. These areas generally contain less intersection densities, less amenities on route, less 'eyes on the street' and often even a lack of sidewalks in cul-de-sac designs. Streets are partitioned by individual driveways often containing 2-3 cars per home. In the winter months, these areas become even more difficult to walk to the far destinations which surround them.

Transit Access: These areas have little access to transit. They generally abutt minor secondary transit corridors which are often not in walking distance to most units.

Access to Amenities by Walking: As stated in the analysis, these ares are extremely mono-functional. This created difficulty in accessing amenities through walking.

Access to Amenities by Transit: Access to transit and distance to amenities is poorly ranked within these areas.

Outer Ring Expansion

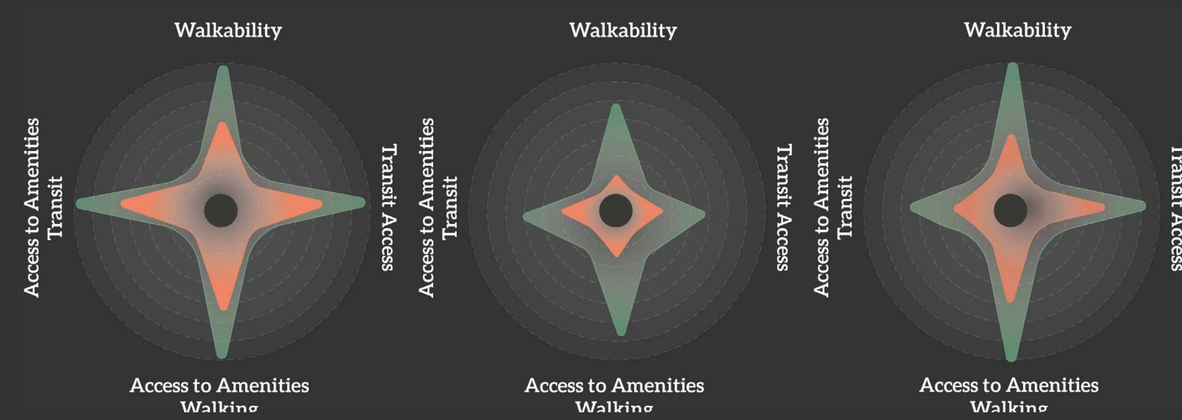
Walkability & Automobile Oriented Design: Most of all new Outer Ring Expansion and Greenfield development uses subdivision design at recently high densities. These areas generally contain less intersection densities, less amenities on route, less 'eyes on the street' and often even a lack of sidewalks in cul-de-sac designs. Streets are partitioned by individual driveways often containing 2-3 cars per home. In the winter months, these areas become even more difficult to walk to the far destinations which surround them.

Transit Access: These areas have little access to transit unless abutting a primary transit station. They generally abutt minor secondary transit corridors which are often not in walking distance to most units.

Access to Amenities by Walking: As stated in the analysis, these ares are extremely mono-functional. This created difficulty in accessing amenities through walking.

Access to Amenities by Transit: Access to transit and distance to amenities is poorly ranked within these areas.

Mobility Performance Indicators Findings: Opportunities



Urban Intensification

Walkability & Automobile Oriented Design : Urban Intensification offers many opportunities to increase walkability in urban regions. Many of these areas are already dense and many urban areas already have a historic, walkable fabric to build off of. The location, density, and building functions could easily increase the walkability of urban intensification. More focus on street frontage and less focus on high parking ratios can make a more walkable environment. Access to trails and creation of trail connections can also enhance the North-South passageways which exist in the urban areas.

Transit Access: The Urban Areas have the highest opportunities for densifying near transit stations and hubs. Most of the transit stations in these areas are surrounded by industrial lands and large swaths of parking. These hold the opportunity to be redeveloped as a multifunctional community to increase access to transit through growth.

Access to Amenities by Walking: Urban intensification must focus on providing new amenities on building ground floors and on walkable streets.

Access to Amenities by Transit: Urban intensification has the highest access to amenities through transit. Yet these amenities are rarely mixed use and still mono-functional at a large scale.

Inner Ring Expansion

Walkability & Automobile Oriented Design: Most of all Inner Ring Expansion and Greenfield development uses subdivision design at recently high densities. Given the densities which these developments are already using, a mix of unit types and street networks can be integrated into the design. Path connections and winterized walking connections (district heating) could be used to incentivise walkability and walkable access.

Transit Access: Developments should focus moderate density along secondary transit lines in order to increase use and avoid the inefficiencies existing in subdivision development.

Access to Amenities by Walking: By integrating new building typologies and strategic density on transit accessways, developments can also target areas for mixed use buildings. These areas can increase the exposure to amenities during walking trips/

Access to Amenities by Transit: Access to transit could increase with increased mixed use types and increased access to secondary transit.

Outer Ring Expansion

Walkability & Automobile Oriented Design: The Polycentric nature of these satellite towns offer the ability to keep the city cores/main streets accessible from all parts of the town. These main centres have historically walkable design and provide street fronting shops and amenities for residents. By developing within close proximity to these streets, growth can take advantage of the existing structure.

Transit Access: These areas have little access to transit unless abutting a primary transit station. The towns with primary transit stations should be the target of the higher amounts of development in the region to gain access to primary stations outside of the urban built boundary.

Access to Amenities by Walking: By integrating new building typologies and strategic density on transit accessways, developments can also target areas for mixed use buildings. These areas can increase the exposure to amenities during walking trips.

Access to Amenities by Transit: Access to transit could increase with increased mixed use types and increased access to primary transit.

Housing & Energy

Due to Ontario's abundant resources, the province's energy production and consumption behavior is diverse and ever-changing. An increasing population causes growth in all sectors, threatening to increase energy consumption and CO2 footprint, while increasing efficiencies, conservation efforts and sustainable energy transitions fight back to lesson these harmful effects. When comparing Ontario's fuel consumption for electricity production with other places around the world, the figures are relatively low CO2 emitting. Nuclear and hydro power form the majority of the centralized electricity production plants in the province. These consist mostly of massive generating stations, meaning the majority of electricity production comes from only a few sites. In 2015, only 10% of electricity was generated using fossil fuels (natural gas), largely due to the complete phase-out of coal fired power plants in the early 2000s and the increase in renewables (Ministry of Environment and Energy, 2017). The total energy consumption, however, paints a different picture. With an increasing transportation sector and the industrial and residential sectors heavily reliant on fossil fuels, the total energy consumption from fossil fuels is immense (Ministry of Environment and Energy, 2017).

Ontario Energy System

Due to Ontario's abundant resources, the province's energy production and consumption behavior is diverse and ever-changing. An increasing population causes growth in all sectors, threatening to increase energy consumption and CO2 footprint, while increasing efficiencies, conservation efforts and sustainable energy transitions fight back to lesson these harmful effects. When comparing Ontario's fuel consumption for electricity production with other places around the world, the figures are relatively low CO2 emitting. Nuclear and hydro power form the majority of the centralized electricity production plants in the province. These consist mostly of massive generating stations, meaning the majority of electricity production comes from only a few sites. In 2015, only 10% of electricity was generated using fossil fuels (natural gas), largely due to the complete phase-out of coal fired power plants in the early 2000s and the increase in renewables (Ministry of Environment and Energy, 2017). The total energy consumption, however, paints a different picture. With an increasing transportation sector and the industrial and residential sectors heavily reliant on fossil fuels, the total energy consumption from fossil fuels is immense (Ministry of Environment and Energy, 2017).

In Ontario, the vast majority of houses rely on a natural gas piping network for their space and water heating needs. As the residential sector represents 18% of total fuel demand in Ontario, this household natural gas consumption represents a substantial portion of fossil fuel need. Ontario's frigid winters create an increased demand on water and space heating, with over 80% of that energy coming from Natural gas (Ministry of Environment and Energy, 2017). Because this extensive natural gas network already exists, it is very easy to extend the gas line to new growth areas, lessoning the motivation to switch to electric furnaces and water heaters.

23% of CO_2 Output in the GTA is due to residential energy use

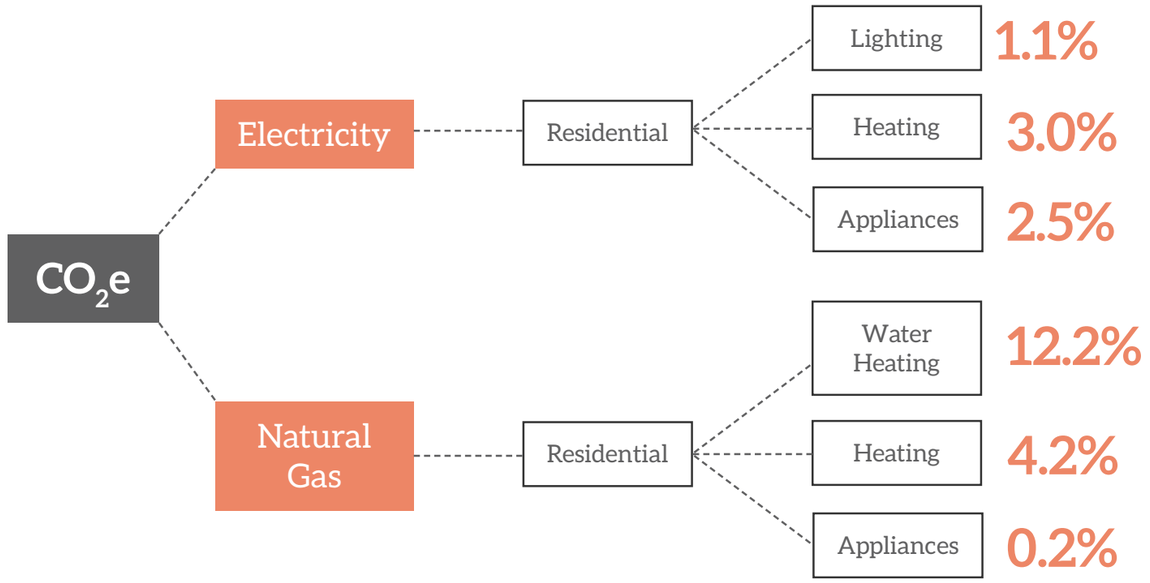


Figure 63 Percentage of Detached Homes. *Source: The Boston Group 2008*

Percentage of Single and Semi-Detached Homes

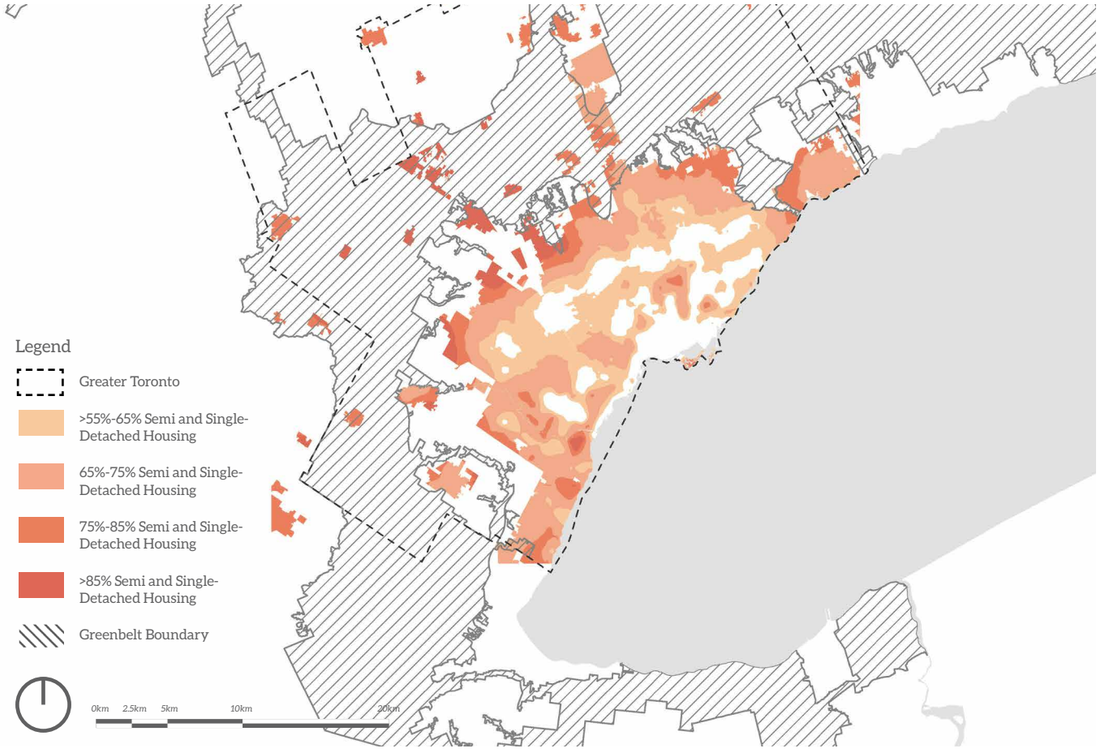


Figure 64 Percentage of Detached Homes. *Source: Census Canada Analyzer Datasets*

Energy Consumption and Housing

Energy use in residences depends on a number of factors including the type of dwelling, ownership structure, dwelling age and household income. It is interesting to note, however, that the total energy use in residences per square meter of floor space has declined 11% in 10 years. This is largely due to an increase in efficient technologies, improved building code and increasing urbanization and housing density (Ministry of Environment and Energy, 2017). However, the current building design trends in the suburban areas are threatening to increase the average energy use per meter. Most of this growth is being managed through building single-detached dwellings with large footprints. A person driving through these growth centres would see swaths of identical single-detached dwellings, each with a driveway and a small backyard. Through looking at Ontario's energy consumption data we know that "households living in apartments used less energy on average (44GJ) than households living in single-detached dwellings (137GJ) Apartments also used less energy per square metre of heated area" (StatsCanada150, 2015) This means that the energy used in the semi-detached buildings that are being built at an increasing rate can be three times as high as it's apartment counterpart. Apartments generally have a smaller floorplan, less energy intensive appliances and less heat loss due to common shared walls. A more sustainable future includes more mixed use buildings and apartments where less total energy is consumed per meter.

Population growth in the GTA has resulted in higher demand for electricity and natural gas for industry and building heating. However, as much of Toronto's electricity distribution system was built between 1940 and 1970, the aging equipment is posing a threat to people's electricity and economic security (Toronto Hydro). The leading cause of power outages in Toronto is from aging equipment, a problem that will not fix itself without investing in new electricity infrastructure (Toronto Hydro). This investment will most likely be passed on to the customer who will experience a rise in electricity prices, incentivising the government to strike a balance between a reliable network and an affordable one. In terms of natural gas, a constantly growing region means an increase in natural gas infrastructure. In 2015, the major natural gas distributor implemented a huge pipeline upgrade to better serve it's doubled number of customers (The Canadian Press, 2014). Because the infrastructure is mostly underground, it is at less of a risk for damage than above-ground electricity networks. However, over time, this infrastructure still needs to be upgraded to meet increasing demand.

Detached Housing Average Energy Use

0.8 GJ per m²

Semi-Detached Housing Average Energy Use

0.7 GJ per m²

Apartments Average Energy Use

0.4 GJ per m²

Figure 65 Ministry of Environment and Energy, (2017) Long-Term Energy Plan: Discussion guide. Province of Ontario

27% heating is electric

57% of home heating is natural gas

Figure 66 Ministry of Environment and Energy, (2017) Long-Term Energy Plan: Discussion guide. Province of Ontario

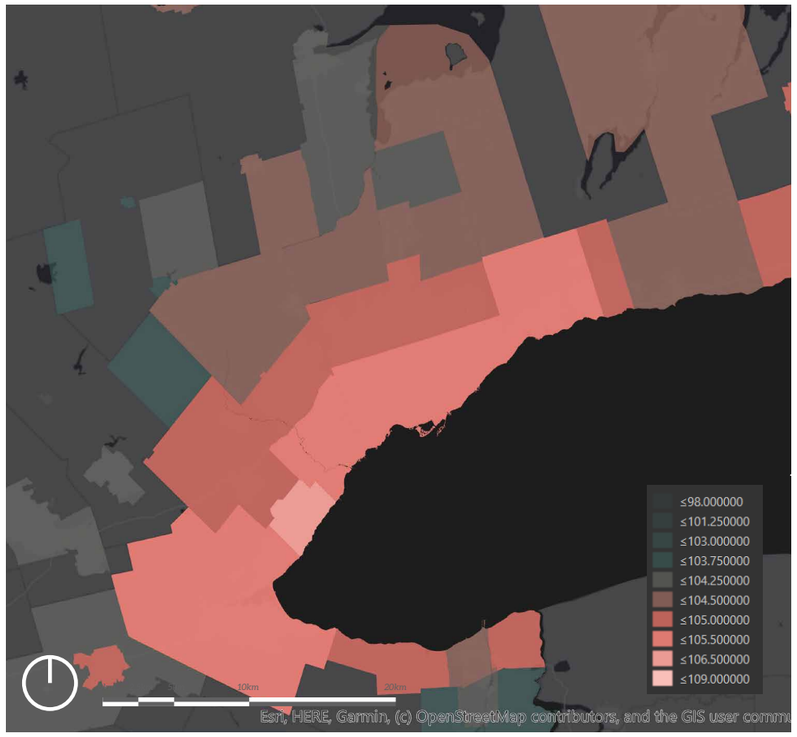


Figure 68 Photovoltaic Potential Canada Municipal Scale Source: Scholars Geoportal

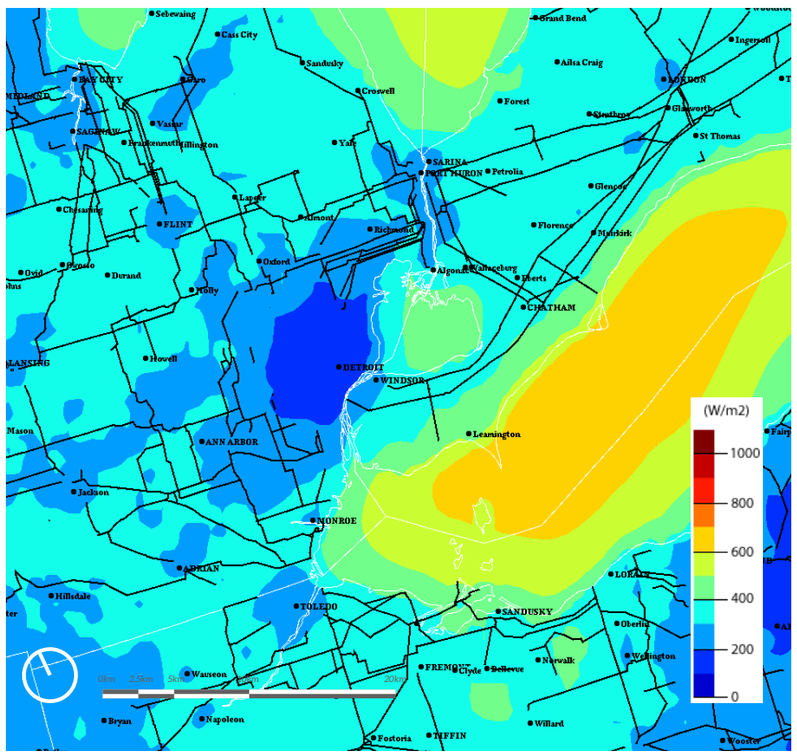


Figure 67 Government of Canada Wind Atlas (2004). Government of Canada.

Renewable Energy Possibilities in the GTA

As previously stated, much of the electricity in the region is produced through hydroelectric and nuclear sources. This creates reduced urgency when it comes to transitioning to renewable energy sources in the future. The primary issue lies within the heating of residential. Urban Intensification has higher performance in heating due to compact form, but Inner Ring and Outer Ring Expansion are primarily innefficient non-compact forms which consume more heating per square meter. This should be the primary focus of a regional energy plan. This can include key urban sites for infrastructure improvements for residual or district heating, as well as requirements for expansion typologies to develop sustainable new heating infrastructure.

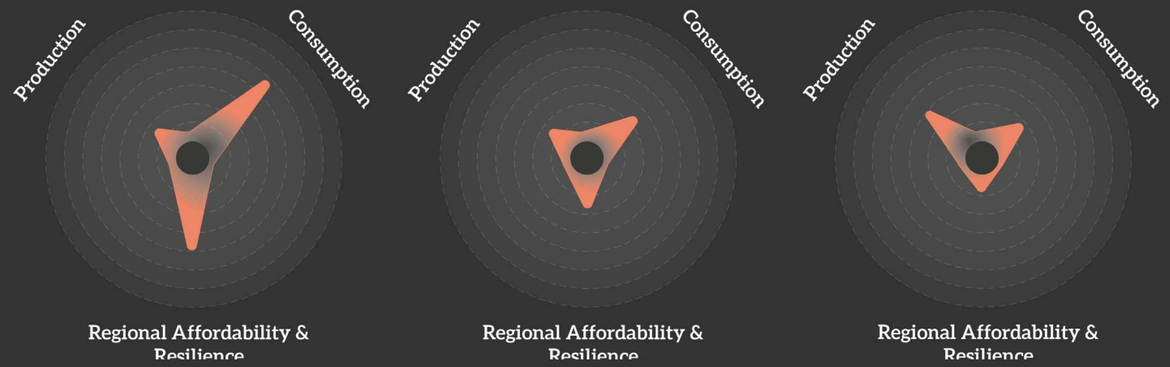
Uncertainty in the Outer Ring

The Outer Ring differs from the other growth typologies as electricity is provided by HydroOne, a less consistent service due to the expansive network it must provide. This is the one growth typology where renewable and resilient electricity sources should be strongly insisted for future development. New infrastructure and compact forms in these rural communities can improve the electrical access and livability within these communities.

Figure 69 Toronto Star, 2017

6.4 Conclusions on Energy and Growth Typologies

Energy Performance Indicators Findings: Issues



Urban Intensification

Production: In terms of energy production, the Urban Intensification has had less opportunity to promote energy production. The ownership models of condominium creates a more difficult environment for the production of energy as condo corporations must agree to collectively invest in renewable energy systems. This could change with rental units, where rental companies may front the cost of these projects as a long-term investments, but many new urban intensification projects are not providing such rental units.
In terms of Biogas and Wind energy, these production methods aren't realistic for urban areas due to hazards and odor.

Consumption: The analysis has shown that housing typology in new development can drastically change the amount of energy to heat living units. Urban intensification is primarily consisting of high rise developments- creating more shared walls and less heat loss than smaller, detached housing units. Also, many larger scale apartments are heated through electricity rather than natural gas, lowering the emissions even more.

Regional Affordability and Resilience: Again, individuals have less opportunities to transition their own energy systems in current multi-unit homes. As energy prices increase this created an unfair advantage to those who own detached and semidetached homes with separate roofs and infrastructure.

Inner Ring Expansion

Production: Inner Ring Expansion generally creates detached or semi detached housing on greenfield land. Currently, this growth type relies on individuals to purchase power production systems for their own homes.

Consumption: Within the current development context of inner ring expansion, most buildings are developed with natural gas heating systems. This is one of the largest contributors to CO2 emissions in the region.

Regional Affordability and Resilience: The infrastructure necessary to expand energy within these areas is extensive and costs municipalities, energy operators, and the provincial government large amounts of funding.

Outer Ring Expansion

Production: Current types of development in the Outer Ring are similar to that of the inner ring with detached and semi detached housing where individuals are responsible to transition to renewable energy themselves.

Consumption: Within the current development context of inner ring expansion, most buildings are developed with natural gas heating systems. This is one of the largest contributors to CO_2 emissions in the region.

Security and Resilience: Many towns within Outer Ring Expansion are part of an older historic infrastructure. This infrastructure connects the rural network which is less dense and more expansive than its urban counterparts. These systems are owned by a different energy company (HydroOne) which generally will experience more black outs and higher energy costs per month.

Energy Performance Indicators Findings: Opportunities

Urban Intensification

Production: Urban Intensification areas have the ability to create community energy initiatives in the form of co-operatives within owned and rented unit structures. These areas also have the ability to use buffers to infrastructure such as highway and rail corridors for the production of electricity and solar thermal. As seen in the solar possibilities map above, the highest amounts of PV are located within the urban areas of the region.

Consumption: Urban intensification already is primarily built of apartment / multi-family units. Introducing mixed-scale housing should be able to maintain this level of heat consumption. Rent vs Owned units can also affect the use of energy and the management of energy consumption. Rented units on average use less energy than owned units. The introduction of more rental units in the project can introduce lower consumption in mixed income buildings.

Security and Resilience: Less infrastructure needs to provided by energy authorities within urban areas due to the density and units reached per metre. The lessened impact on infrastructure creates long term affordability for the authority and for residents.

Inner Ring Expansion

Production: Inner Ring Expansion provides opportunities for new, better infrastructure due to the lowered costs of construction in greenfield development. New developments have the possibility of integrating district heating into developments from the start in order to reduce heating emissions in expansion areas. These areas also have an increased amount of open spaces for small scale wind projects and possible biomass/ biogas production for district heating.

Consumption: These developments which are already being built at high densities have the ability to include a new mix of housing typologies which will improve heat loss from building monotonous buildings.

Security and Resilience: By creating new infrastructure systems with a more compact design, the distance of infrastructure will likely decrease, as well as add opportunities for decentralized systems which will resist shocks to the larger high voltage network.

Outer Ring Expansion

Production: Outer Ring Expansion has a high amount of potential in terms of energy production. The towns themselves are still compact which offers opportunities for energy landscapes in the outer ring of the towns and for new sustainable infrastructure such as district heating.

Consumption: These developments which are already being built at high densities have the ability to include a new mix of housing typologies which will improve heat loss from building monotonous buildings.

Security and Resilience: By creating new infrastructure systems with a more compact design, the distance of infrastructure will likely decrease, as well as add opportunities for decentralized systems which will resist shocks to the larger high voltage network.

Ecosystem Services

The main research question of this research sets out to identify methods to 'increase biocapacity' through urban growth . The term 'biocapacity' was used, as it is directly related to ecological footprint. However, biocapacity analysis in itself, does not necessarily create a detailed view for what ecosystems can offer for regions, and what regions can offer to improve ecosystems. Therefore, in order to explore increasing 'biocapacity' the following analysis is based on 'Ecosystem Services'. Ecosystem services sustain human and non-human activities through four types of services: supporting services (water and nutrient cycling), provisional services (food production, fuel, wood), regulating (water purification, erosion control, habitat), and cultural (aesthetic and spiritual values) (Wratten, Sandhu, Cullen, & Costanza, 2012). The values within biocapacity are only considering what is considered 'provisional service', therefore, this section of the research will evaluate the different qualities of ES which can be evaluated by the land cover raster data from 2015. The same methods which were used to measure ES values in Ontario based on land cover in the study, Estimating Ecosystem Services in Southern Ontario, which uses various cross-referenced data to value ES (2009).

The watersheds $409 million in filtration, $189 million in water treatment and $379 million for flooding annually

167,364 tonnes of carbon worth $11 million per year

325,000 ha of habitat and lands which conserve biodiversity

$93 million in recreational value

Figure 70 (Troy & Bagstad, 2009)

The Value of Measuring Ecosystem Services

When considering the choice to convert different types of landscapes surrounding the GTA to subdivisions, it is critical to understand the existing services which they provide. The greenbelt itself provides seemingly limitless services with water filtration, treatment, flood protection, habitat, carbon sequestration, and recreational value. Given this, the Province, regions, and municipalities use the Greenbelt plans in order to limit expansion into these areas. Yet, even with this protection boundary, the Whitebelt remains open for future development. Not only does expansion into the belt decrease agricultural land, it creates greater pressure on the abutting ecosystems. This includes greater water runoff, pollution, and air quality issues.

The valuation of these services within the growth areas in the GTA allows us to gain a more in-depth understanding of the direct consequences of land conversion. Additionally, the valuation of ES also allows perspective on the value of our urban systems which run through the GTA. The connection and preservation of these areas may be key in increasing 'biocapacity'/Ecosystem Services in the region.

Table 3: Per-hectare ecosystem service value estimates cross-tabulated by land cover and service type

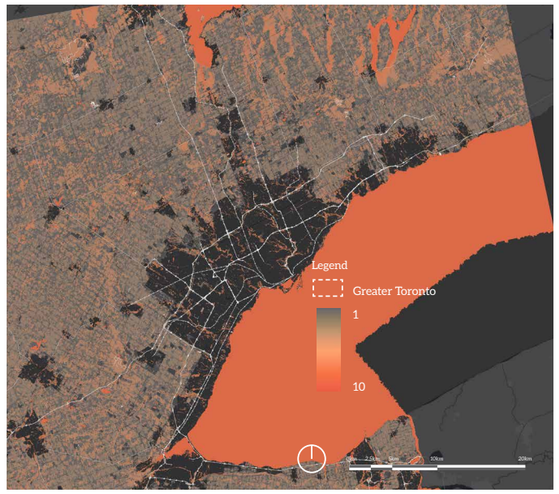
CATEGORY	Recreation	Aesthetic/ amenity	Other cultural	Pollination & dispersal	Habitat refugium/ biodiversity	Atmospheric regulation	Soil retention erosion control	Water quality/ nutrient & waste regulation	Water supply/ regulation	Disturbance avoidance	TOTAL
Agriculture											
Agriculture	$137		$97	$28		$31					$291
Grassland/Pasture/Hayfield	$53		$134	$19	$95	$19	$4	$25		$5	$353
Forest											
Forest: Non-urban	$270		$240		$2,428	$992		$513			$4,443
Forest: Urban	$14,903		$249	$7,536		$992		$513	$1,649		$25,843
Forest: Suburban	$11,373		$249			$992		$513	$1,649		$14,777
Forest: Adjacent to stream	$559				$133	$992	$779	$621	$1,320	$148	$4,552
Forest: Hedgerow			$7	$25		$992					$1,023
Urban herbaceous											
Urban herbaceous greenspace		$43,539	$249								$43,788
Open water											
Open water: River	$8,655		$25		$10			$33,906	$12,957		$55,553
Open water: Urban/suburban river	$172,691	$242						$45,768	$17,690		$236,392
Open water: Inland lake	$3,820	$593	$25					$612			$5,050
Open water: Great Lake nearshore	$554	$240									$795
Open water: Estuary/tidal bay	$451	$1,289			$13			$54	$45		$1,852
Wetlands											
Wetlands: Non-urban, non-coastal	$3,551	$6,446	$2,286		$75	$14		$2,779			$15,171
Wetlands: Urban/suburban	$9.861	$129				$14		$3,168	$48,929	$99,318	$161,420
Wetlands: Great Lakes coastal	$590	$2,527	$8,970			$14		$2,660			$14,761
Beach											
Beach: general	$72,892	$1,386								$15,330	$89,608
Beach: Near structures	$96,635	$2,773								$30,660	$130,068
Beach: Not near structures	$49,150										$49,150

Figure 71 Ecosystem Services. *Source: Estimating Ecosystem Services in Southern Ontario (Troy & Bagstad, 2009)*

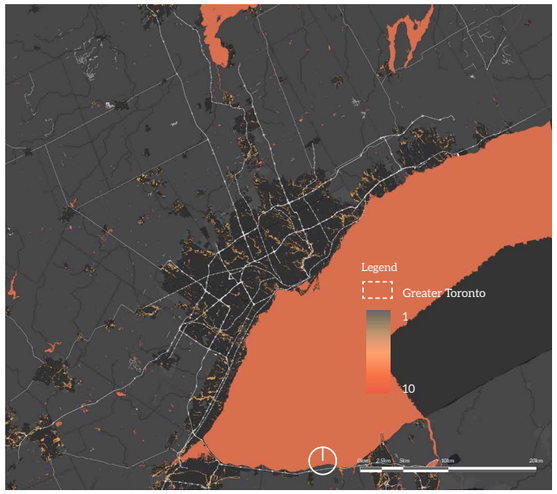
Valuing Land Cover Method

Using the study, Estimating Ecosystem Services in Southern Ontario, this section of the report is intended to create a basic 'value' for ES using land cover data for Southern Ontario. The referenced study refers to direct cost value in dollars, but for the purpose of this analysis, these costs were converted into a 1-10 score value. The table above references the average value of land cover broken down into types. Considering this study used the same National Land Cover dataset, the same variations were used for land cover breakdown. In order to separated Urban, Suburban, and Rural, the classifications were separated using the built up boundary.

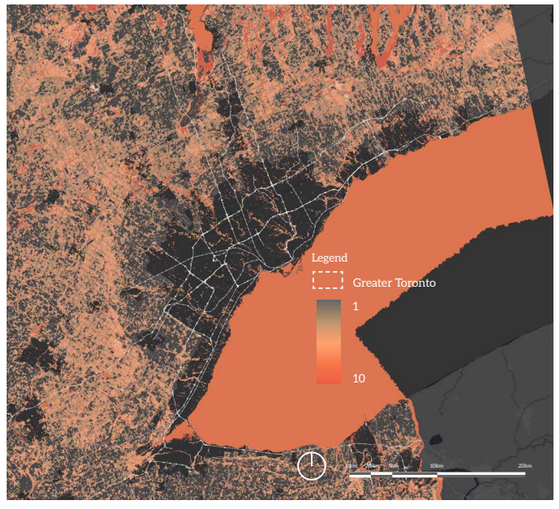
Recreation Values



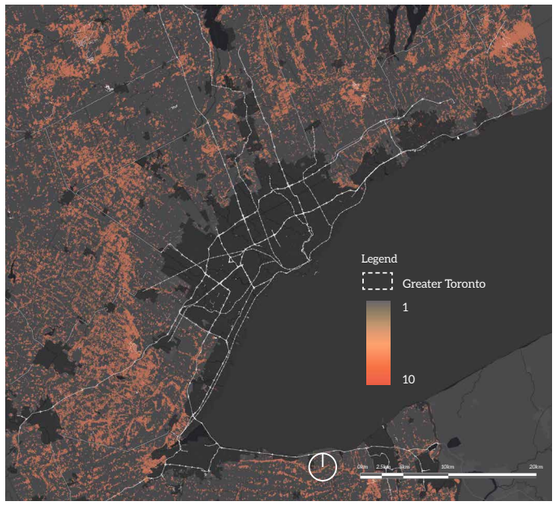
Water Supply Values



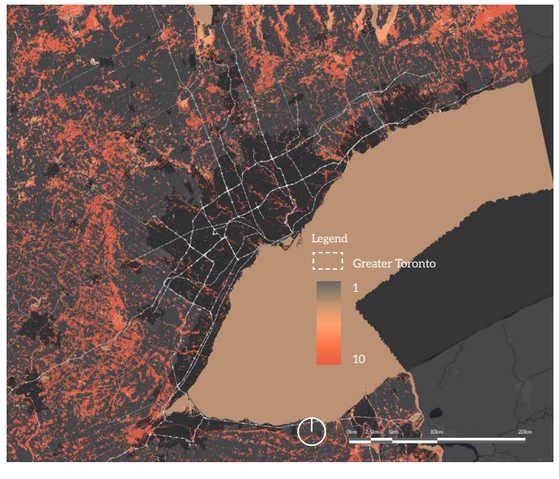
Water Quality Values



Soil Retention Values



Habitat Values



Atmospheric Regulation Values

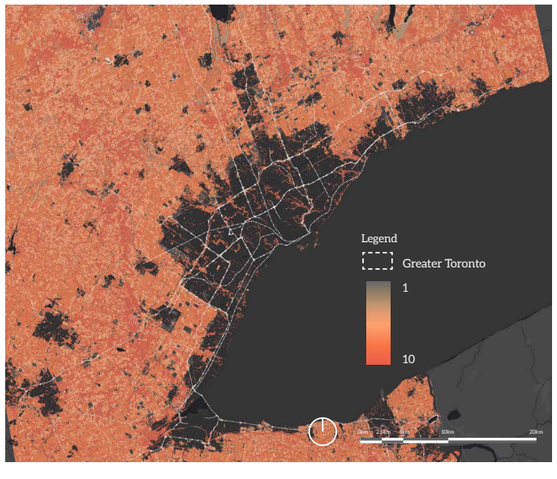


Figure 72 Ecosystem Services. *Source: Canada Land Cover (2015) (Troy & Bagstad, 2009)*

Sum of Ecosystem Service Values

The following map is a sum of all of the ecosystem services values. Where the individual analysis for each ecosystem service theme is valuable for specific solutions in the project, the sum also highlights the vital role of some land cover types within the entire system. It is clear that within the urban regions, forests and wetlands are incredibly valuable systems, yet most of the strong connections within the systems run (roughly) North-South, limiting access for residents living between the ravine systems. In terms of the Inner Ring, it is evident that much of the land cover is of high-value forests and wetlands as well. Additionally, agricultural lands which will likely be the target for Greenfield development have a surprisingly high value, due to the high values associated with recreation and atmospheric regulation performed by farmland. Evidently, the Outer Ring area includes the highest amount of high value lands given that most remain virtually unaffected by dense residential communities. These areas also reside in the regional Greenbelt boundary. The continued over-expansion of these towns clearly threaten the value of such ecosystems and should be thoroughly restrained from unnecessary growth into the farmlands within the Greenbelt plan.

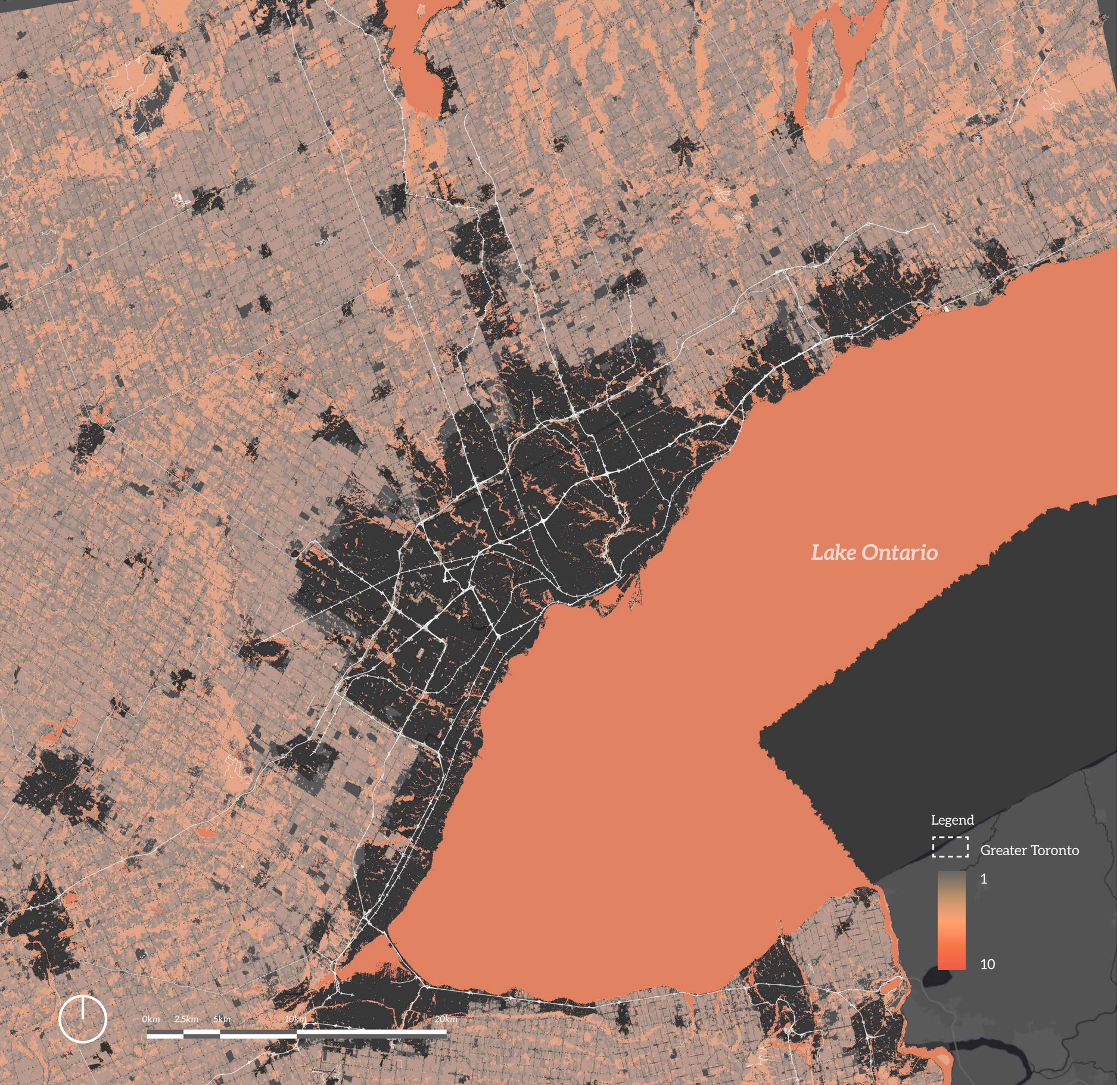


Figure 73 Ecosystem Services. *Source: Canada Land Cover (2015)*

Accessibility to Parks by Walking (15 minutes)

In order to understand culture and recreational ecosystem services beyond land cover, the following map is an analysis of the walkability to parks and natural systems within a 15 minute walk. The following map depicts the access to parks and conservation areas within the GTA. As previously discussed, the river networks which are the connecting natural features through all regions, create significant access to green within communities.

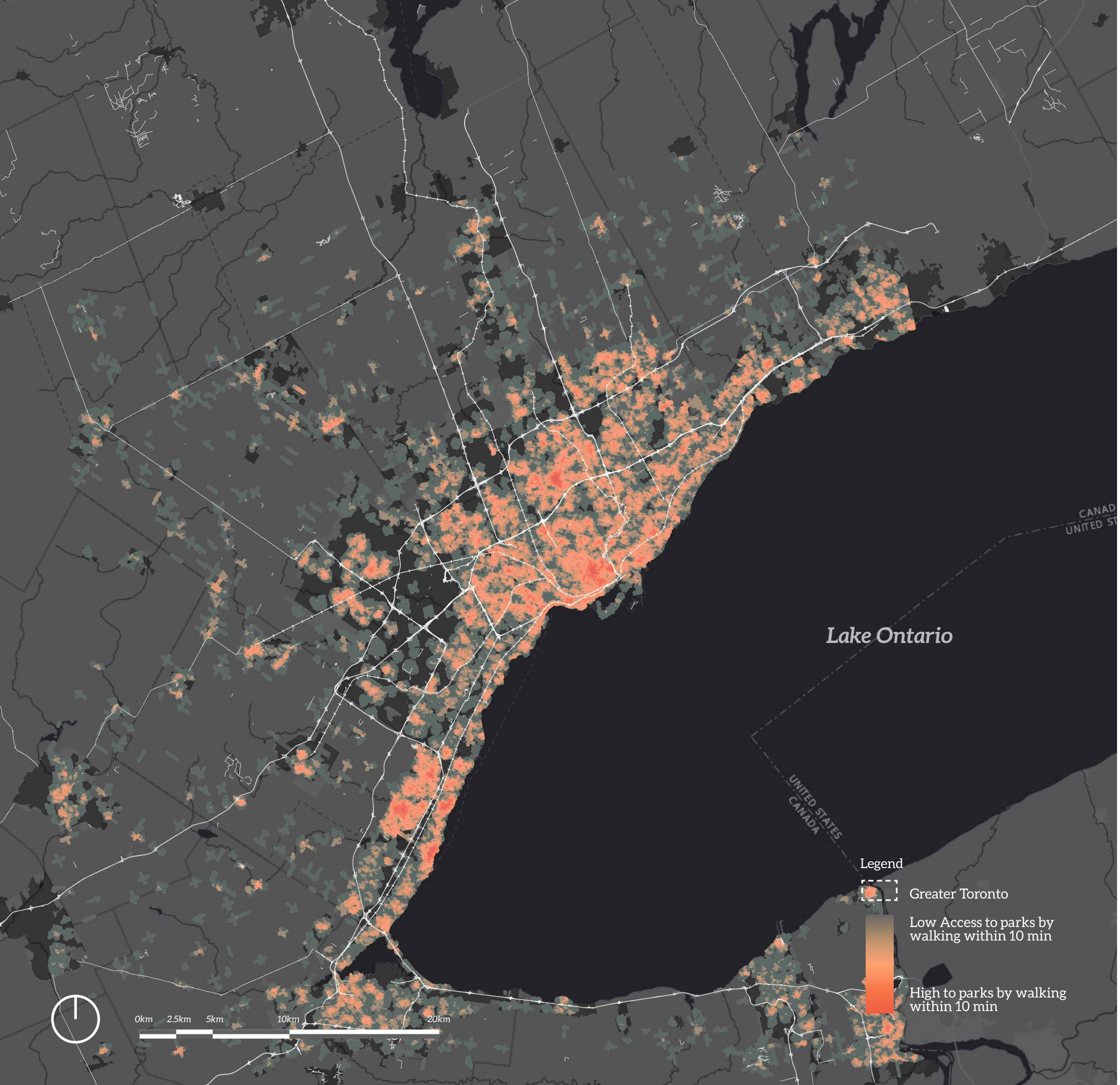
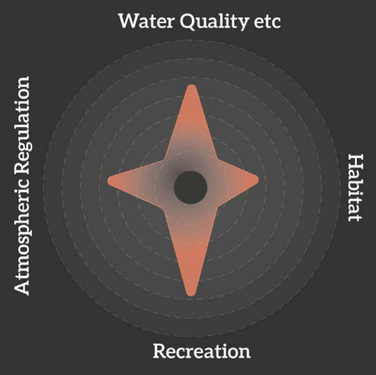


Figure 74 Access to Parks. *Source: Scholars Geoportal & Yellow Pages*

6.5 Conclusions on Ecosystem Services and Growth Typologies

Ecosystem Services Performance Indicators Findings: Issues



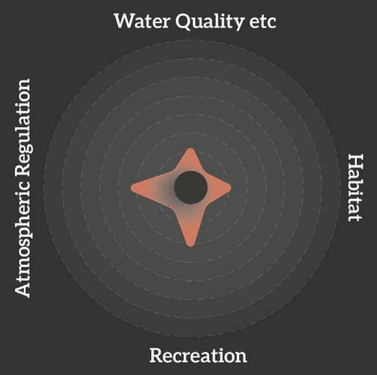
Urban Intensification

Water Quality, Supply & Soil Retention: Forests, wetlands and open water are the most vital to the water quality and water supply system (Troy & Bagstad, 2009). It is clear that much of the development of urban intensification is not necessarily converting these landscapes, but also not contributing to water retention using softscaping and water collection. As previously stated, the land cover on much of the urban intensification lands are hardscaping creating a neutral affect with new development.

Habitat: The primary habitats within the region are within non-urban forests, and pasturelands in the outskirts of the city. Again, land use conversion for Urban Intensification does not take away from these landscapes, but it also does not have real capacity to incorporate habitat for the ecosystem in current development.

Recreation: Urban intensification has the highest walking access to parkland and natural conservation land within the growth types even though it is located within more urban regions. Yet, within urban areas density does not generally occur abutting these recreational corridors whereas private single family homes often back onto natural areas within the urban built zone.

Atmospheric Regulation: Of course forested and treed areas have the highest amount of atmospheric regulation followed by agricultural lands, grasslands and wetlands (Troy & Bagstad, 2009). Again, these lands are rarely converted in urban intensification, but the growth areas studied do no introduce a significant amount of CO_2 regulating species.



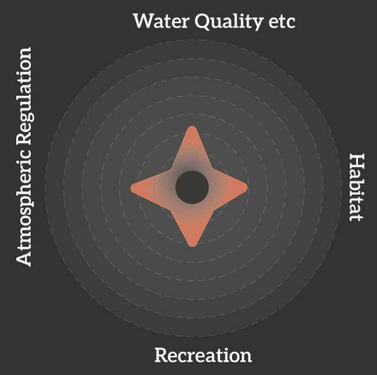
Inner Ring Expansion

Water Quality, Supply & Soil Retention: Forests, wetlands and open water are the most vital to the water quality and water supply system (Troy & Bagstad, 2009). Generally, these land uses are incorporated into the conservation ravine lands through several different conservation authorities. Yet, inner ring expansion is still affecting these land uses through urban expansion. The current flood plains (if in existence) in Ontario are measure to the 100 year flood mark. Inner ring areas build until this mark. The issue remains that with a changing climate and ever-increasing storm runoff, these areas are causing pressures on the water system (Mcclearn, 2019).

Habitat: The primary habitats within the region are within non-urban forests, and pasturelands in the outskirts of the city. As inner ring areas expand into pasturelands and develop in close proximity to non-urban forests, habitats are being limited to the exterior greenbelt.

Recreation: While residents flock to the inner ring to gain more space, the ravine network and park spaces are more difficult to access through walking or biking than urban intensification areas. This means that more recreational ecosystem land covers do not mean that there is more access, or more access per capita for that matter. Agricultural land is also considered to be of recreational and agricultural use (Troy & Bagstad, 2009). The loss of this land is considered to be a loss of recreation and cultural services.

Atmospheric Regulation: Inner ring expansion areas are growing into agricultural land. The highest regulating and supporting service which agricultural land provides is atmospheric regulation (Troy & Bagstad, 2009). When losing these areas to development, there is not just provisional service loss, but also atmospheric.



Outer Ring Expansion

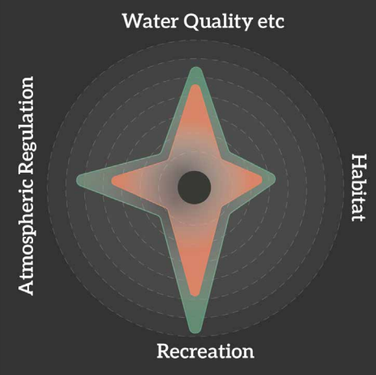
Water Quality, Supply & Soil Retention: Forests, wetlands and open water are the most vital to the water quality and water supply system (Troy & Bagstad, 2009). Generally, these land uses are incorporated into the conservation ravine lands through several different conservation authorities. Yet, outer ring expansion is still affecting these land uses through urban expansion. The current flood plains (if in existence) in Ontario are measure to the 100 year flood mark. Outer ring areas build until this mark. The issue remains that with a changing climate and ever-increasing storm runoff, these areas are causing pressures on the water system (Mcclearn, 2019). What makes matters worse for outer ring expansion, is that most town are located within the greenbelt. Urban expansion within the host of the most significant areas for water quality, supply and retention poses a problem for the ecosystem as a whole. The introduction of sewage plants within these areas also poses a threat to the existing natural system surrounding.

Habitat: The primary habitats within the region are within non-urban forests, and pasturelands in the outskirts of the city. As inner ring areas expand into pasturelands and develop in close proximity to non-urban forests, habitats are being limited to the exterior greenbelt. This issue is even more significant within the greenbelt.

Recreation: Residents move to the outer ring often for open space of agricultural and forested lands. Yet the expansion of these very municipalities are beginning to eliminate these landscapes which will no longer be in walking distance for residents.

Atmospheric Regulation: Of course forested and treed areas have the highest amount of atmospheric regulation followed by agricultural lands, grasslands and wetlands (Troy & Bagstad, 2009). Again, these lands are rarely converted in urban intensification, but the growth areas studied do no introduce a significant amount of CO_2 regulating species.

Ecosystem Services Performance Indicators Findings: Opportunities



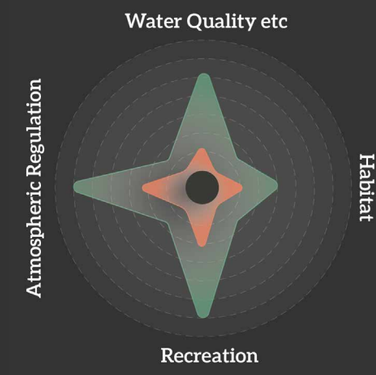
Urban Intensification

Water Quality, Supply & Soil Retention: While there is a lacking amount of space in many urban intensification projects, natural systems may be integrated into new development using trail paths, buffer lands, roof tops, and podiums. Water also has the possibility of being collected from large rooftops and to be re-used within consumption.

Habitat: Urban Intensification is unlikely to provide significant habitat, but the creation of softscaping and rooftop gardens may provide microsystems for smaller mammals and insects.

Recreation: Though urban intensification has the highest access to recreational land cover areas, it is important to improve connections to these areas where there are walkable, naturalised trails connecting the existing east-west ravine system. Rather than 'saving' abutting recreational lands for single family housing, there is a larger opportunity to densify these areas to increase access per capita to natural spaces.

Atmospheric Regulation: The plantation of grass and gardens, but especially trees and small forested areas will increase the atmospheric regulation of the urban ecosystem.



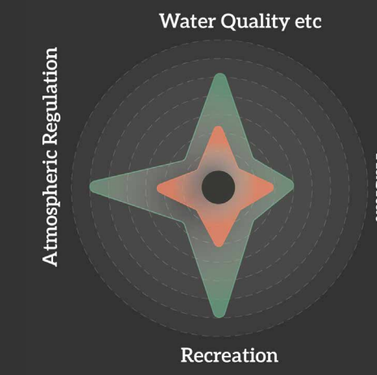
Inner Ring Expansion

Water Quality, Supply & Soil Retention: When considering water quality, supply and retention in future development, it is vital to increase the existing floodplain to take existing and future pressure off of the ravine system. Inner Ring Developments should also limit the amount of hardscaping in development, including an increased around of road infrastructure per person in developments.

Habitat: By creating more compact developments in the inner ring, non-urban forest will continue to remain 'non-urban' with less visitors and less impact from the adjacent suburban system.

Recreation: By increasing walkability and East-west connections in developments, inner ring expansion could highlight the natural services which surround these neighbourhoods, rather than limiting accessibility to directly adjacent neighbourhoods and by car access.

Atmospheric Regulation: Extending the 100 year flood plain will extend the forested lands and wetlands which will improve atmosphere regulation.



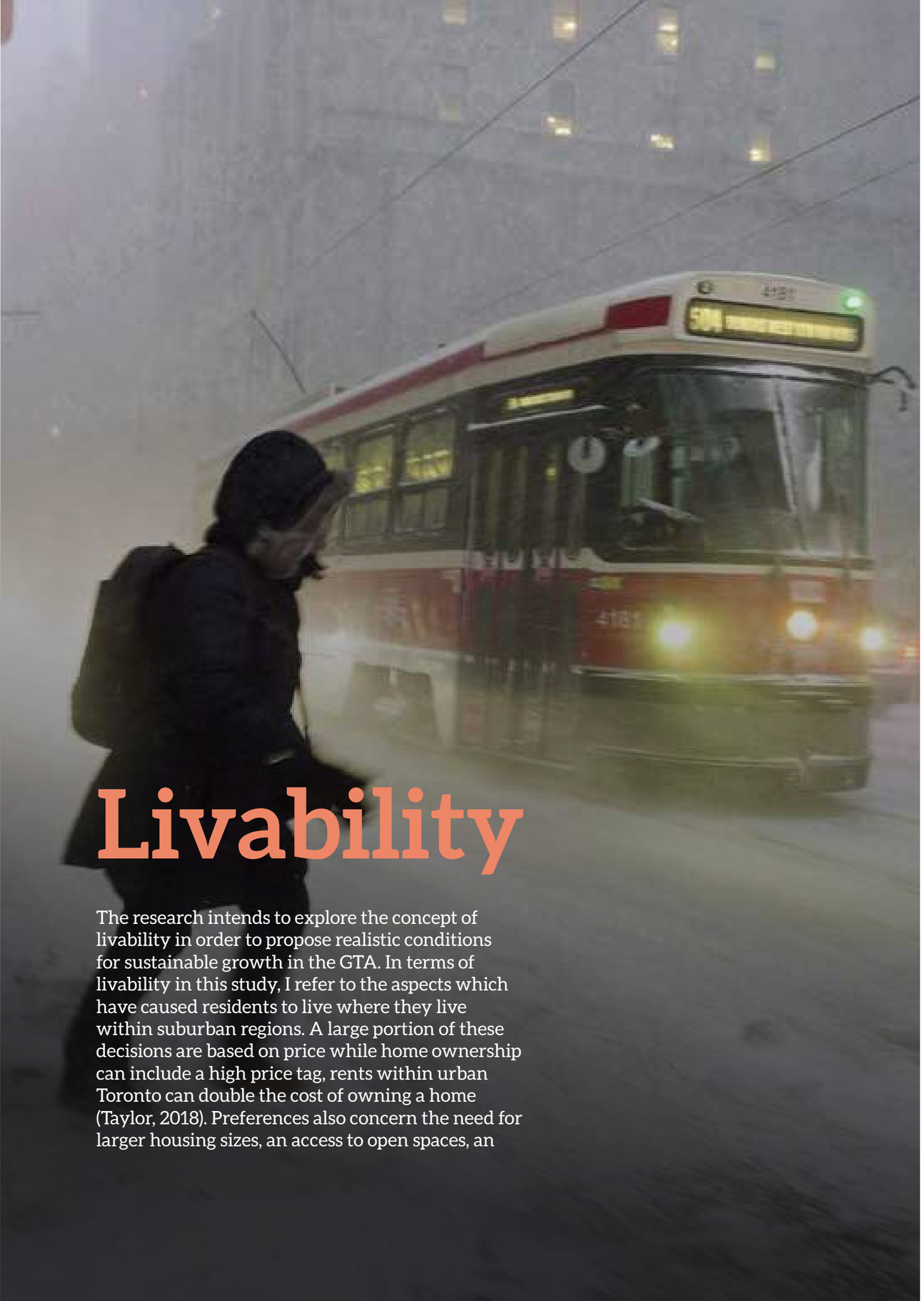
Outer Ring Expansion

Water Quality, Supply & Soil Retention: When considering water quality, supply and retention in future development, it is vital to increase the existing floodplain to take existing and future pressure off of the ravine system. Outer Ring Developments should also limit the amount of hardscaping in development, including an increased around of road infrastructure per person in developments.

Habitat: By creating more compact developments in the outer ring, non-urban forest will continue to remain 'non-urban' with less visitors and less impact from the adjacent suburban system.

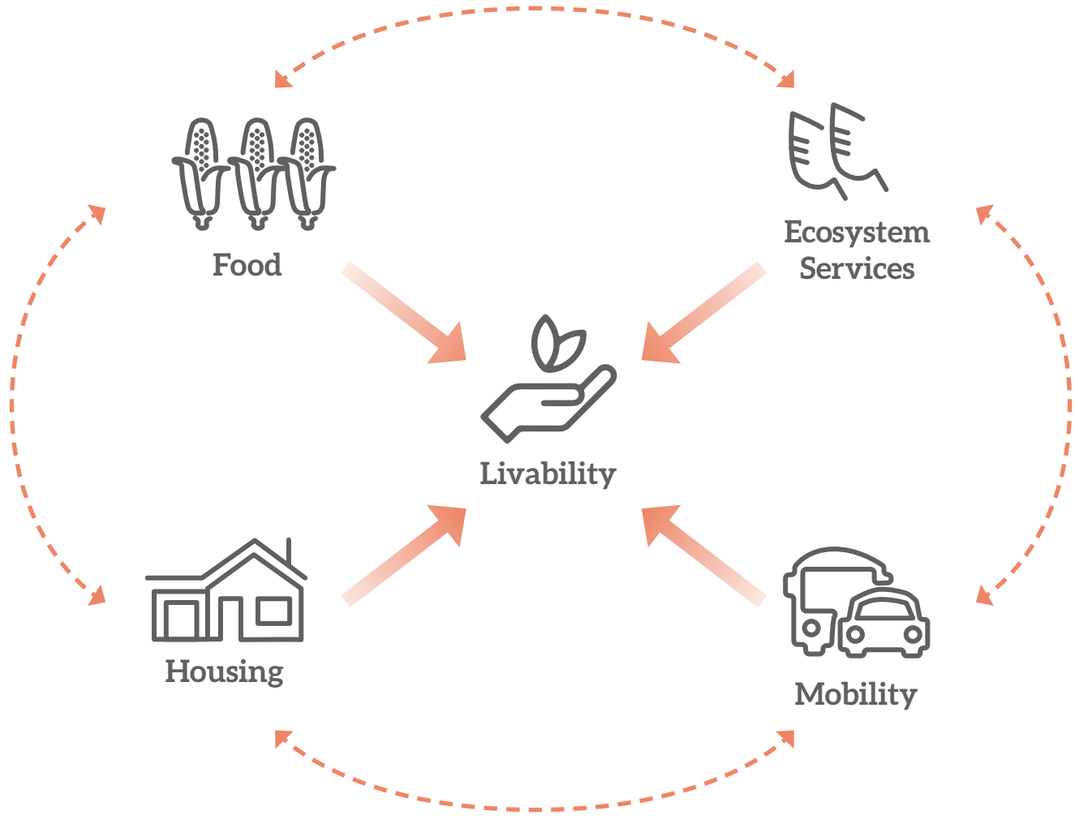
Recreation: By increasing walkability and East-west connections in developments, outer ring expansion could highlight the natural services which surround these neighbourhoods, rather than limiting accessibility to directly adjacent neighbourhoods and by car access.

Atmospheric Regulation: Extending the 100 year flood plain will extend the forested lands and wetlands which will improve atmosphere regulation.



Livability

The research intends to explore the concept of livability in order to propose realistic conditions for sustainable growth in the GTA. In terms of livability in this study, I refer to the aspects which have caused residents to live where they live within suburban regions. A large portion of these decisions are based on price while home ownership can include a high price tag, rents within urban Toronto can double the cost of owning a home (Taylor, 2018). Preferences also concern the need for larger housing sizes, an access to open spaces, an



Livability and Sustainability Indicators

Livability and the chosen indicators for sustainability are closely linked within many themes. The main attribute is access: access to food, access to sustainable modes of transport, access to affordable energy, and access to ecosystem services as well as a resilient and sustaining ecosystem. The following section will explore the relationship to these themes, as well as the core issue of affordability and ownership in obtaining livability within the GTA. The following is a detailed explanation of the indicators within the context of livability.

Food

Again, livability and food are connected through access. Firstly there is a key importance of access to food. This has not only to do with access to any food, but access to affordable and healthy food within walking distance. Creating more accessible food distribution and production and creating incentives for consumers and producers could increase this aspect of livability. Food is also connected to recreation through production and distribution. The production of food, either in an agricultural landscape or community garden provides cultural and recreational services to the community, allowing integration and social cohesion.

Mobility

Mobility has recurring themes of livability within its framework. Access to several modes of transportation beyond the automobile creates an accessible network for the entire population, including those who cannot or choose not to drive. Accessibility to sustainable transport modes allow young persons, elderly persons, an alternative to mobility limitations. Car oriented neighbourhoods also assume that residents can and will afford a car, created a new type of unjust segregation.

Housing

The energy system is transitioning in Ontario. Electricity and natural gas prices seem to be continuously on the rise. Residents should have the ability to access or invest in community energy systems, or personal energy systems which can reduce their CO_2 emissions, and also reduce their energy costs. As wealthier home owners convert to renewable electricity, it is vital that lower income renters and owners have the same opportunities to create the energy transition as well.

Ecosystem Services

Access to recreation and cultural areas within ecosystems have already been discussed as a key aspect of livability within ecosystem services. The effects of Ecosystem services which are seemingly less obvious, are the regulating and supporting services which ecosystems bring to the region and the broader nation. Enhancing and preserving these services can create more resilient systems which will limit the effects from weather events. One especially relevant issue is that of flooding in the GTA. Currently the floodplains have served to fail the province and the region. This has in turn negatively affected resident's quality of life and increased risks on their livelihoods.

Livability and Affordability

The following map contains the data for housing price within the GTA. These are the housing costs in order to buy/own a housing unit within these census tracts. Though generally residents are moving outwards for the affordable, this data reveals that newer suburbs in inner expansion areas have become less and less affordable. Yet for buyers looking for larger housing for families within urban intensification areas-these units are often unavailable for them (Canadian Centre for Economic Analysis, 2017). Buildings within urban intensification areas became targeted towards young urban professionals, and unit sizes have followed (Canadian Centre for Economic Analysis, 2017). In these areas, the price per square meter compared to development in the outer region is significantly higher. There is also a discrepancy between ownership units and purpose-built rental units which is at the core of the large scale affordability issues within the region.

The solution of a new 'missing middle' and introduction of rental units and mixed income housing has been proposed within the region in order to introduce more compact living and create a more affordable environment for incoming populations (Canadian Centre for Economic Analysis, 2017).

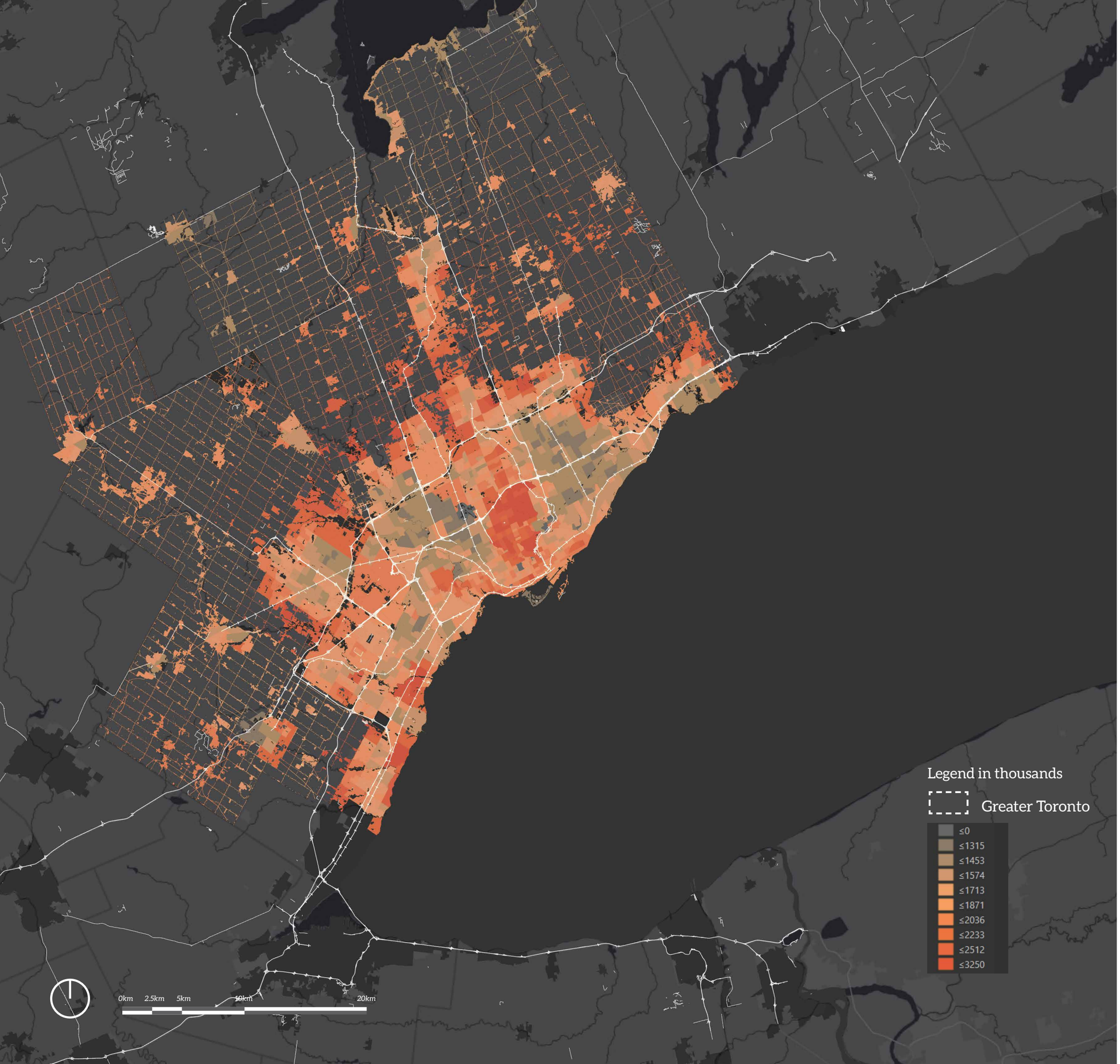


Figure 75 Average Housing Price. *Source Census Canada 2016*

Figure 76 Main Street Newmarket Canada Day Soure: Stephen Hayes Photography

Vision for a Greater Toronto

7.0 Developing Spatial Strategies for Growth in Greater Toronto

Issues and Opportunities to Strategies

The issues and opportunities identified within the analysis and conclusions will allow the project to move towards strategic solutions to the problems. In order to develop these strategies, this chapter will establish the existing spatial parameters which are relevant for development in each growth area. The strategies will then be based off of the opportunities matched with the spatial conditions of these areas.

What if Scenarios

The What if Scenarios are intended to test selected strategies on specific chosen sites in the region. The scenarios pose the question of, 'What if' because the end goal is to understand the possibilities and the limitations with the strategies in order to make a more educated and experimental based decision on the recommendations for future growth.

Regional Growth Recommendations

Based on the conclusions from the what if scenarios, the recommendations are intended to summarize the research into final recommendations for different growth types moving forward. These recommendations will ideally mitigate and improve the issues that the region will most likely face with future development and population growth. Based off the insights from the descriptive analysis and design investigations, the next step is to draft a preliminary strategy for growth in the GTA using the multi-scalar strategies as noted within the scenarios. The regional strategy will first focus on the regional vision, drawing out possibilities for growth centres or expansion areas/opportunities. The plan will then expand on how these ideal locations and expansion strategies can possibly reduce ecological footprint, preserve or increase biocapacity, and also maintain a high quality of life. This will ideally be evident through comparison to the planned expansion/intensification of the Toronto Region executed earlier in the Descriptive Analysis.

Issues

↓

Existing and Potential Opportunities

↓

Spatial Parameters

↓

Strategies

↓

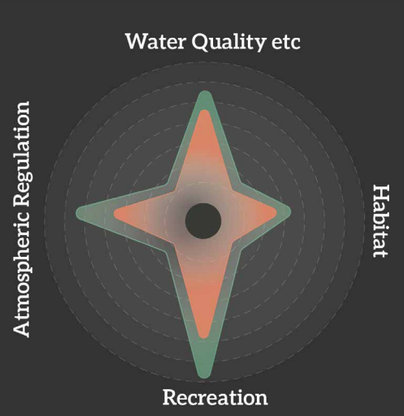
Evaluation

↓

Conclusions

8.0 Developing Strategies from Opportunities for Urban Intensification

The following opportunities are collected from the analysis of each theme for Urban Intensification. These opportunities are to be integrated into Spatial Strategies below.



Ecosystem Services

Water Quality, Supply & Soil Retention: While there is a lacking amount of space in many urban intensification projects, natural systems may be integrated into new development using trail paths, buffer lands, roof tops, and podiums. Water also has the possibility of being collected from large rooftops and to be re-used within consumption.

Habitat: Urban Intensification is unlikely to provide significant habitat, but the creation of softscaping and rooftop gardens may provide micro-systems for smaller mammals and insects.

Recreation: Though urban intensification has the highest access to recreational land cover areas, it is important to improve connections to these areas where there are walkable, naturalized trails connecting the existing east-west ravine system. Rather than 'saving' abutting recreational lands for single family housing, there is a larger opportunity to densify these areas to increase access per capita to natural spaces.

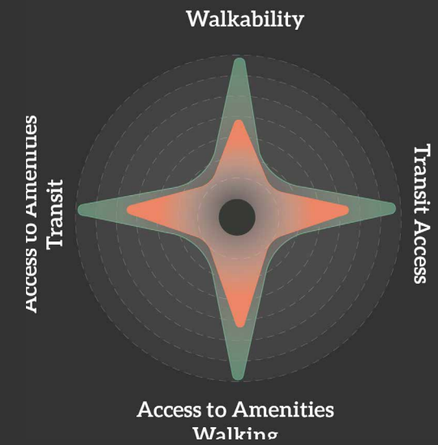
Atmospheric Regulation: The plantation of grass and gardens, but especially trees and small forested areas will increase the atmospheric regulation of the urban ecosystem.

Energy

Production: Urban Intensification areas have the ability to create community energy initiatives in the form of co-operatives within owned and rented unit structures. These areas also have the ability to use buffers to infrastructure such as highway and rail corridors for the production of electricity and solar thermal. As seen in the solar possibilities map above, the highest amounts of PV are located within the urban areas of the region.

Consumption: Urban intensification already is primarily built of apartment / multi-family units. Introducing mixed-scale housing should be able to maintain this level of heat consumption. Rent vs Owned units can also affect the use of energy and the management of energy consumption. Rented units on average use less energy than owned units. The introduction of more rental units in the project can introduce lower consumption in mixed income buildings.

Security and Resilience: Less infrastructure needs to provided by energy authorities within urban areas due to the density and units reached per metre. The lessened impact on infrastructure creates long term affordability for the authority and for residents.



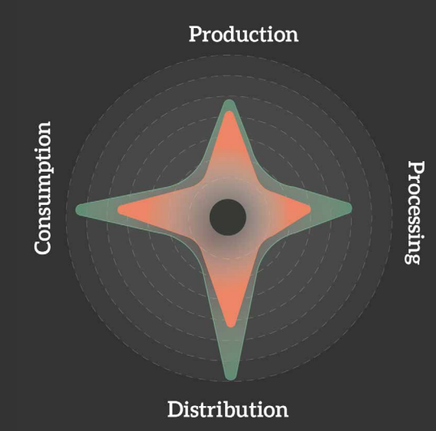
Mobility

Walkability & Automobile Oriented Design : Urban Intensification offers many opportunities to increase walkability in urban regions. Many of these areas are already dense and many urban areas already have a historic, walkable fabric to build off of. The location, density, and building functions could easily increase the walkability of urban intensification. More focus on street frontage and less focus on high parking ratios can make a more walkable environment. Access to trails and creation of trail connections can also enhance the North-South passageways which exist in the urban areas.

Transit Access: The Urban Areas have the highest opportunities for densifying near transit stations and hubs. Most of the transit stations in these areas are surrounded by industrial lands and large swaths of parking. These hold the opportunity to be redeveloped as a multi-functional community to increase access to transit through growth.

Access to Amenities by Walking: Urban intensification must focus on providing new amenities on building ground floors and on walkable streets.

Access to Amenities by Transit: Urban intensification has the highest access to amenities through transit. Yet these amenities are rarely mixed use and still mono-functional at a large scale.



Food

Production: Though Urban Intensification typologies generally have less space, there is still room for small scale community oriented food production. These can occur on roof spaces and infrastructural buffer lands, such as rail and hydro corridors. Though these processes will be of a lesser scale, urban intensification will no be lessening the agricultural land in the GTA, meaning increasing agricultural land will only add to the production of local food, no matter the scale. To add, the climate in the winter months puts a hold to outdoor food production. Urban intensification offers opportunities for winterized green houses and interior production on rooftops.

Processing: The processing which occurs near urban intensification is currently that of vegetable and grain processing in industrial areas.

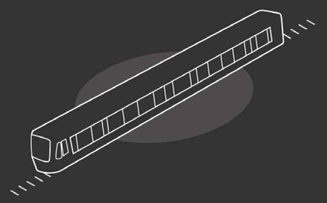
Distribution: While Urban Intensification currently has the highest access to food out of the typologies, it is still important to ease access to food by creating truly walkable connections. These locations should not only be walkable, but also provide smaller scale local food sellers in urban areas using community initiatives and incentives.

Consumption: The focus of consumption in the realm of urban planning should be having access to affordable and local food in order to lower ecological footprint. In order to improve the issue of consumption and waste, there must be education programs and incentives for consuming less and wasting less food.

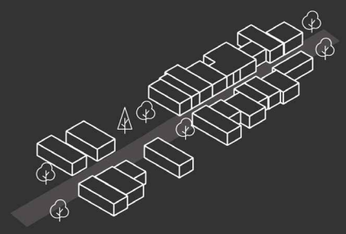
9.0 But... Where?

9.1 Urban Intensification: Existing Spatial Conditions

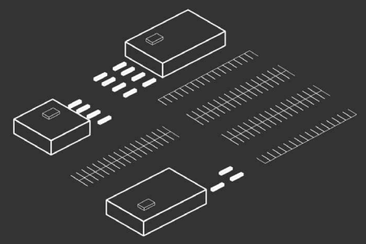
Based on the opportunities analysis of Urban Intensification, strategies must be developed in order to implement changes for the sustainability indicators. The following is a summary of the generic spatial conditions which are found within areas of urban intensification within the built boundary. These spatial conditions are both vital nodes for the community, and also parcels and lots which are opportunities for redevelopment such as monotonous commercial and industrial lands.



Primary Transit Stops and Lines

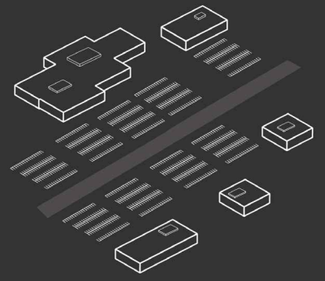


Existing Historic Town Centres

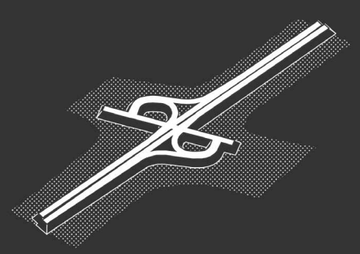


Transitioning Industrial Lands

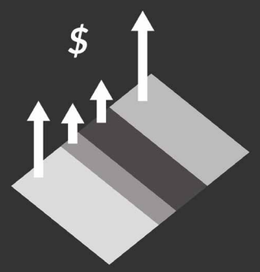
North-South Trail Networks



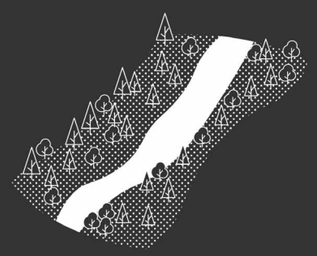
Mono-Commercial Strips



Infrastructural Buffer Lands



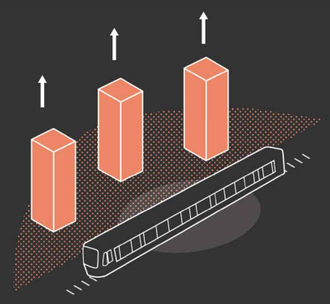
Rising Land Prices



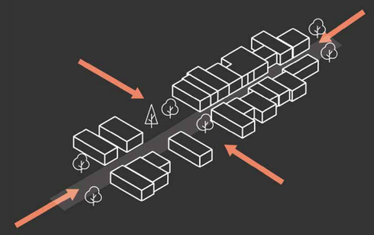
Adjacent Wetlands & Urban Forests

9.2 Urban Intensification: Potential Spatial Strategies

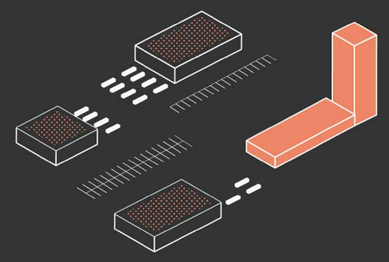
By combining the issues, opportunities, and spatial conditions of the urban boundary, the following are potential strategies to remediate issues of urban intensification. The overall goal of the strategies are to improve the current condition of the "tall and sprawl" highway/mall developments. The region's areas for urban intensification have the opportunity to build off of existing walkable communities, undeveloped transit stations, disconnected ecosystem services, monotonous landscapes, and rising land prices.



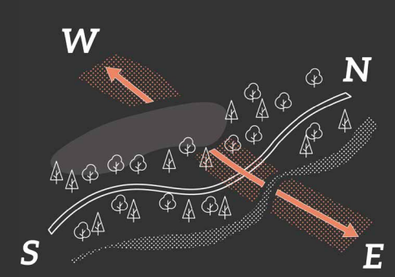
Density on Primary Stops



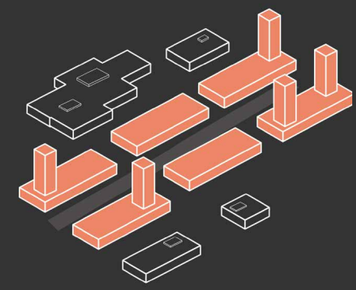
Density with Access to Walkable Town Centres



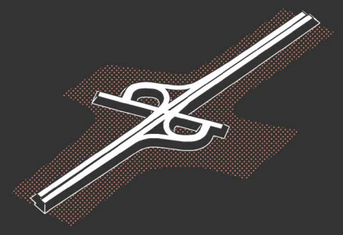
Production systems on abutting rooftops



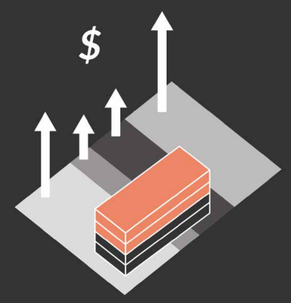
West-East Trail Connections



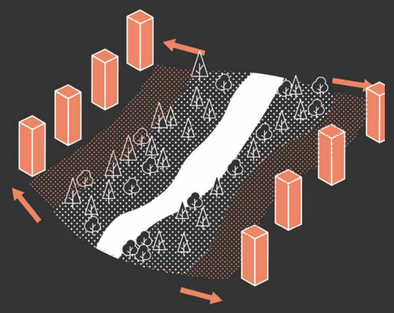
Mono-Commercial Strips to mixed-use streets



Infrastructural Buffer Lands as Energy and Food Production lands



Rising Land Prices



Adjacent Wetlands & Urban Forests

10.0 Generating 'What if' Scenarios

In order to base regional recommendations off of the strategies proposed in the previous section, the next phase of the project will generate 'What if' scenarios. Through these scenarios the study will integrate some of the proposed strategies. Using the scenario as a test, the resulting conclusions and design will provide a more thorough understanding on the realities of developing these strategies in the urban context. The following what if scenarios targets three strategies created for urban intensification and combines them in order to test the possibilities for development.

Urban Intensification

Existing Spatial Conditions

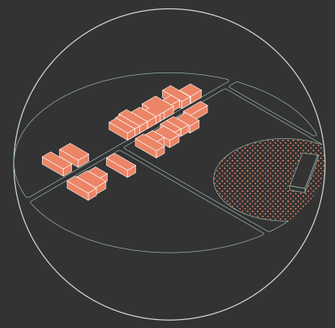
- Primary Transit Stops and Lines
- Existing Historic Town Centres
- Trail Networks
- Large Adjacent Rooftops
- Adjacent Infrastructural Buffer Lands
- Residual Heat Opportunities
- Adjacent Wetlands
- Adjacent Forests
- Low Value Land Costs

+

Proposed Strategies

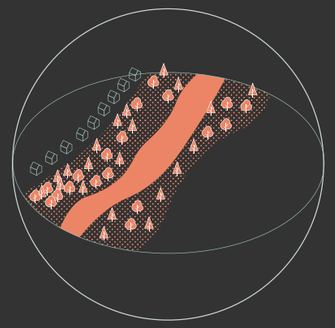
- Rooftop Food Production
- Buffer Lands & Food Production
- Density & Transit Stops
- Connect Trails / E.S. to Transit Connections
- District Heating in New Development
- Rooftop Energy Production
- East-West network
- Densify along E.S. networks
- Mixed Use Development
- Transit and Industrial with Mixed Use Hubs
- Walkable Routes to Transit

10.1 What if:



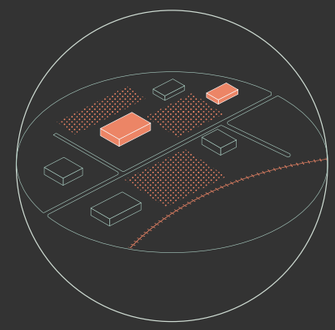
Urban intensification targeted density along transit stations abutting **historic main streets***?*

Many transit stations exist within a sea of parking and industrial zones. Almost all except those which are abutting the historic main streets of the region. Historic main streets are already walkable, livable, and enjoyable cores of the polycentric GTA, yet municipalities barely focus on densifying within walking distance to them. How can growth focus on access to town centres and transit stations?



Urban Intensification was based on **connections to conservation areas***?*

As noted in the analysis of ecosystem services, there is a strong north-south connection of the ravine forest/wetland network across the region. Many of these areas are abutting low-density, monotonous subdivision areas or industrial areas. Can new development focus on access to ecosystem services, while also improving the ecosystem services on site?



Urban Intensification **densified within industrial areas** *often abutting transit stations, and created mixed use/multi-functional hubs?*

Industrial lands are generally abutting the existing suburban GO transit stations. Much of these industrial lands are being developed into mono-functional low rise residential. Can these areas abutting stations be transitioned into mixed use districts while still integrating small scale industrial spaces?

10.2 Locating Spatial Parameters

Major Transit Stations Historic Main Streets, Industrial Areas, Natural Systems

The following maps provide an analysis of the spatial parameters necessary to execute the chosen strategies for this project scenario. Here, transit stations, historic main streets, industrial lands, and parkland/natural lands are projected.

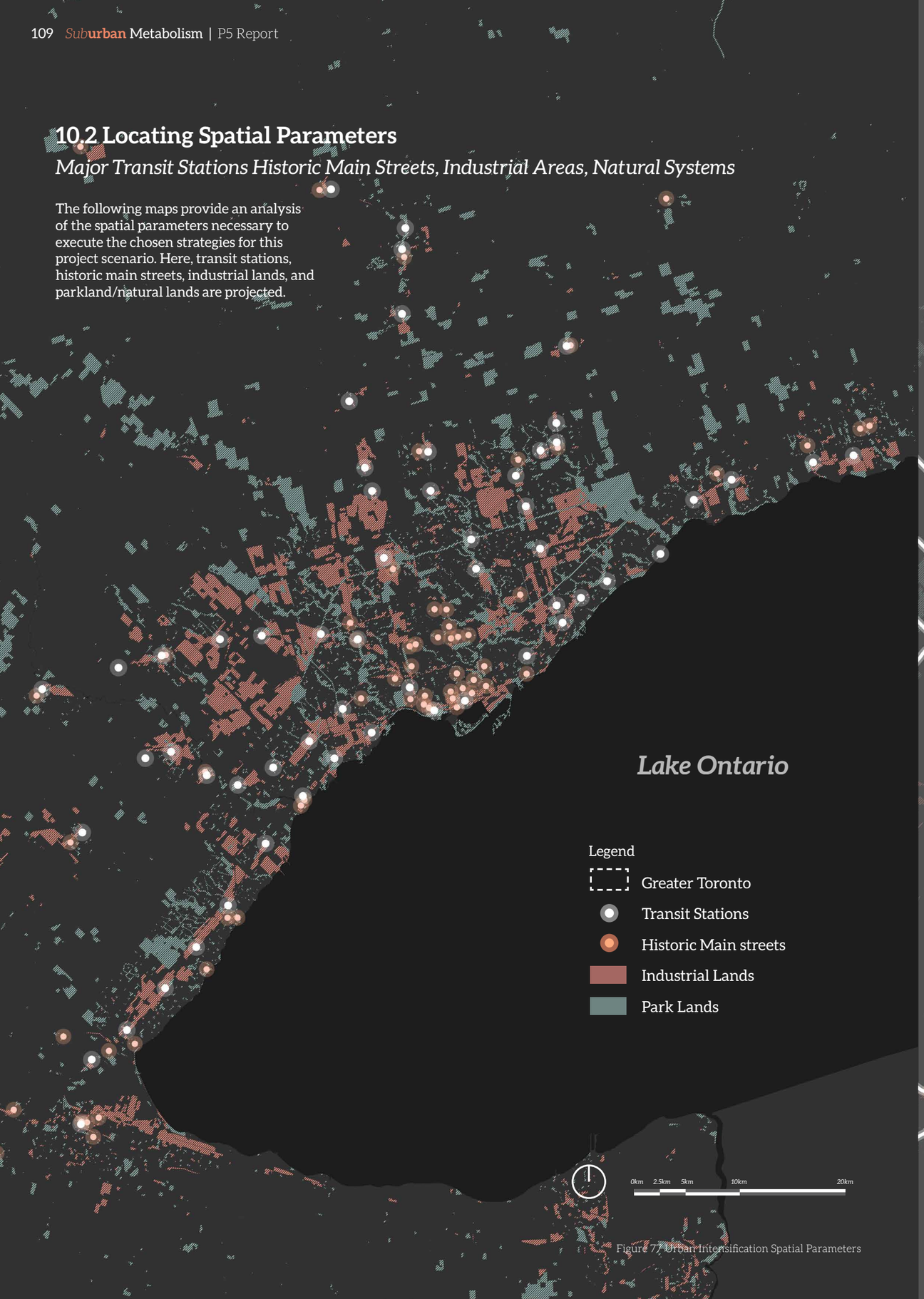


Figure 77 Urban Intensification Spatial Parameters

*Major Transit Stations with Connections to Historic Main Streets within a **15 minute walk***

A GIS network analysis was then run in order to establish GO train stations which have a historic main street within a 15 minute walk. Eight locations were chosen.

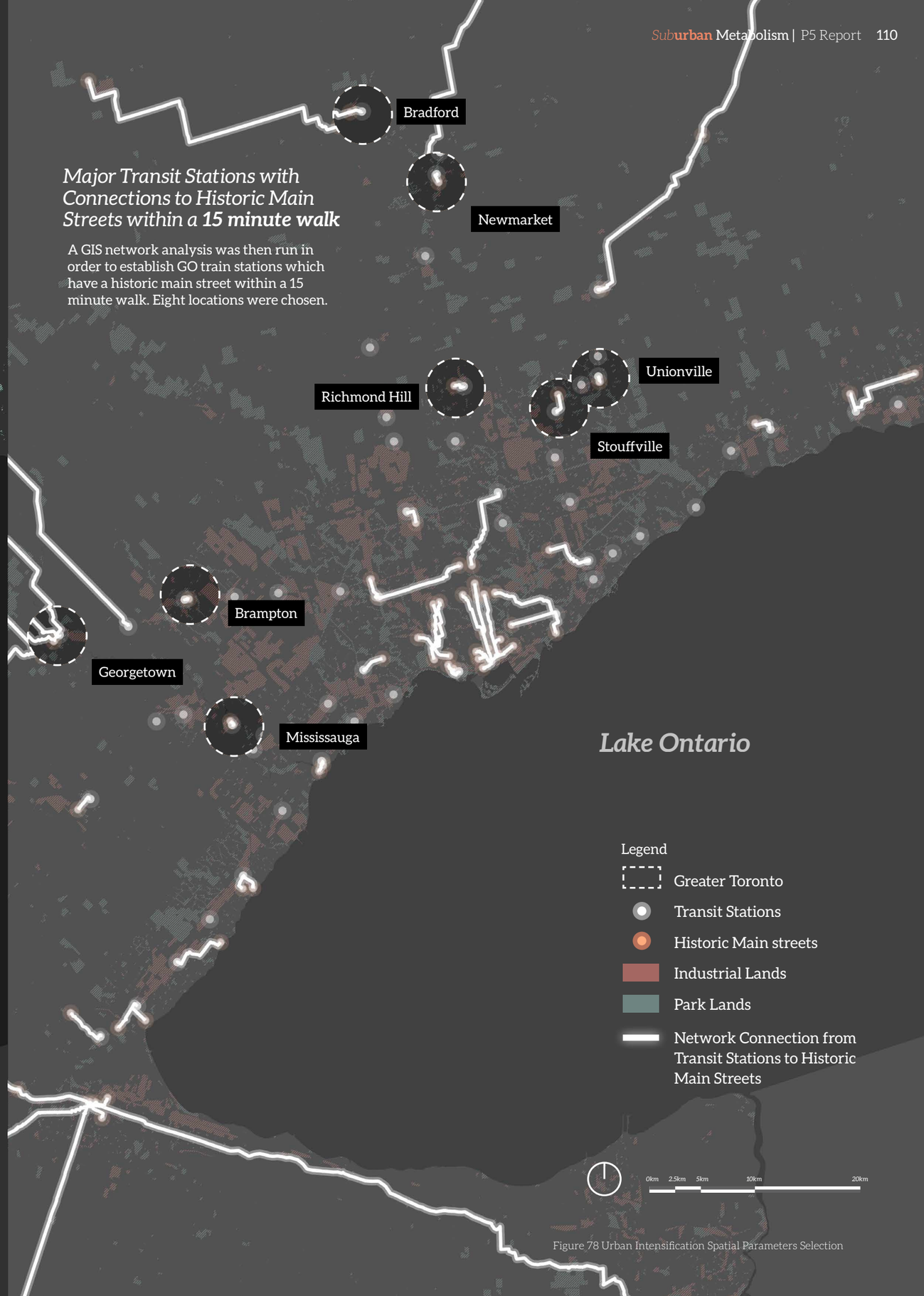


Figure 78 Urban Intensification Spatial Parameters Selection

10.3 Selected Locations

Major Transit With a 15 Minute Walking Isochrone Catchment Area

Legend

- Greater Toronto
- Transit Stations
- Historic Main streets
- Industrial Lands and Mono-functional Commercial
- Park Lands

Georgetown

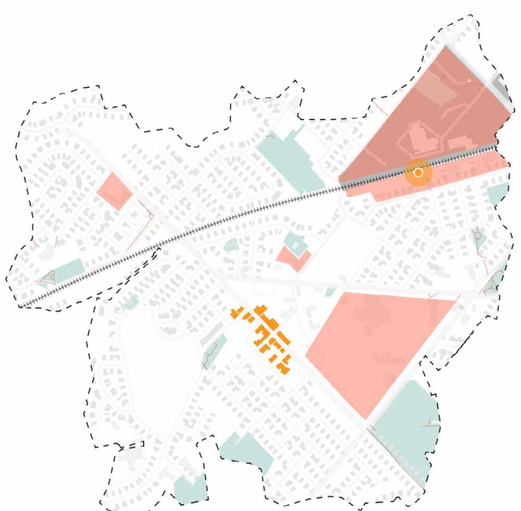


Figure 79 Georgetown Source: Scholars Geoportal Data and OSM

Mississauga

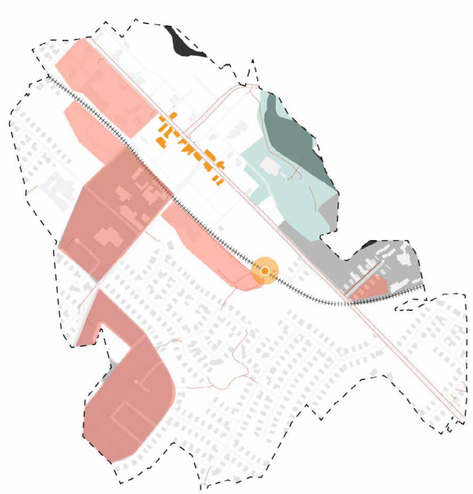


Figure 81 Mississauga Source: Scholars Geoportal Data and

Brampton

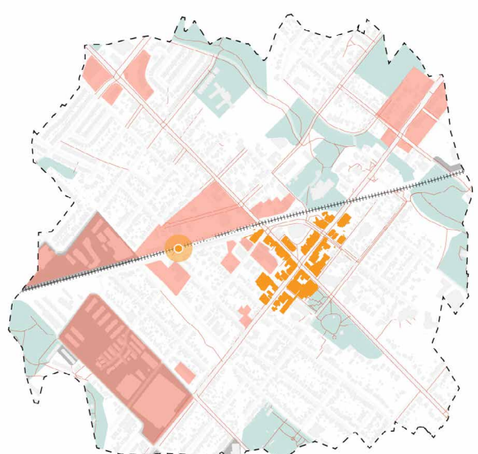


Figure 84 Brampton Source: Scholars Geoportal Data and

Unionville

Figure 86 Unionville Source: Scholars Geoportal Data and

Stouffville

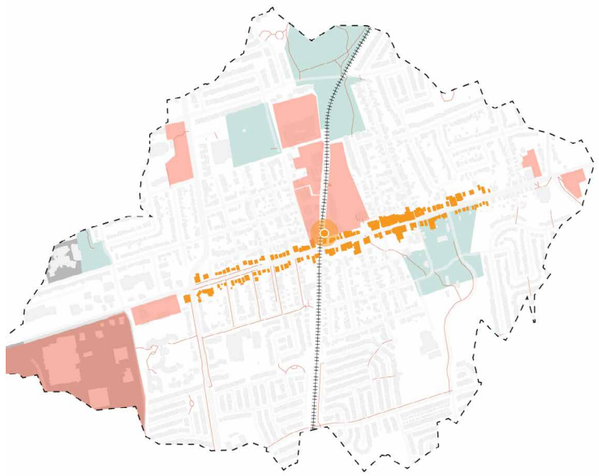


Figure 80 Stouffville Source: Scholars Geoportal Data and

Bradford

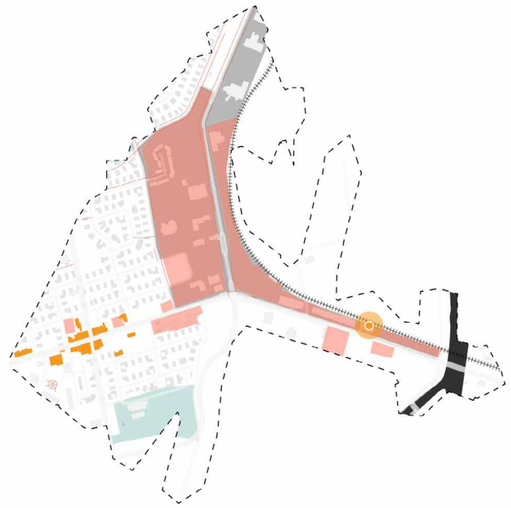


Figure 82 Bradford Source: Scholars Geoportal Data and

Newmarket

Figure 83 Newmarket Source: Scholars Geoportal Data and

Richmond Hill

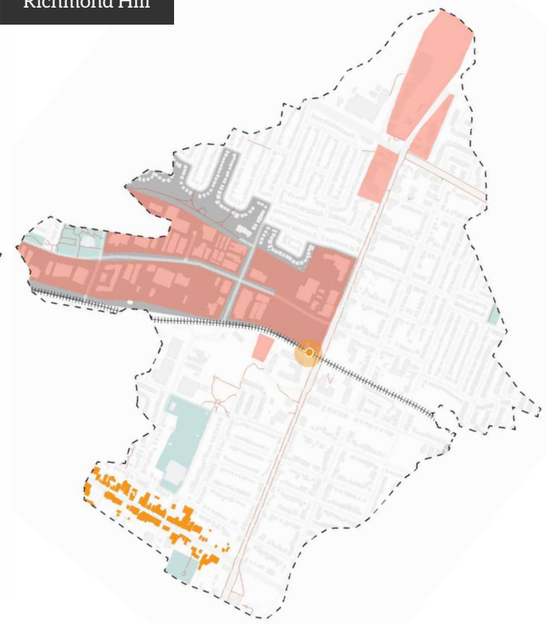


Figure 85 Richmond Hill Source: Scholars Geoportal Data and

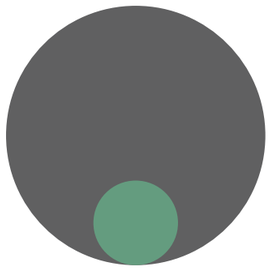
Quantities Available within the Development of Catchment Areas

Through the analysis on available lands within the target locations, it was found that these areas could potentially provide 200 hectares of development lands. This alone could provide for 10% of the 60% targets for intensification and would provide 30% of the current trend projections for growth. Of course, this growth would be paired with other forms of urban intensification which would provide more room for growth.

200 hectares

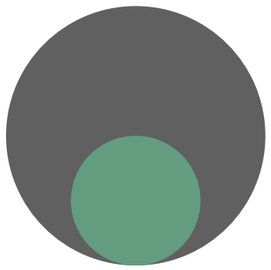
of Potential Development Lands within Industrial and Mono-functional Commercial Lands

Figure 87 Main street Unionville Markham, City of Markham Flickr



10% of the current growth target for intensification

developing in these areas with the growth centres target (200 per ha) would accommodate approx. **40,000 persons**



30% of the current growth trends

400/hectare could allow the areas to reach **80,000 persons**

10.4 Newmarket Ontario

Newmarket Growth Centre and Potential Growth Centre

Figure 88 New Catchment Growth Zone Source: York Region GIS, Esri BaseMaps

Legend

- Isochrone 15-Minutes
- Transit Stations
- Existing Growth Centre
- Buildings

Newmarket Main street Passageway

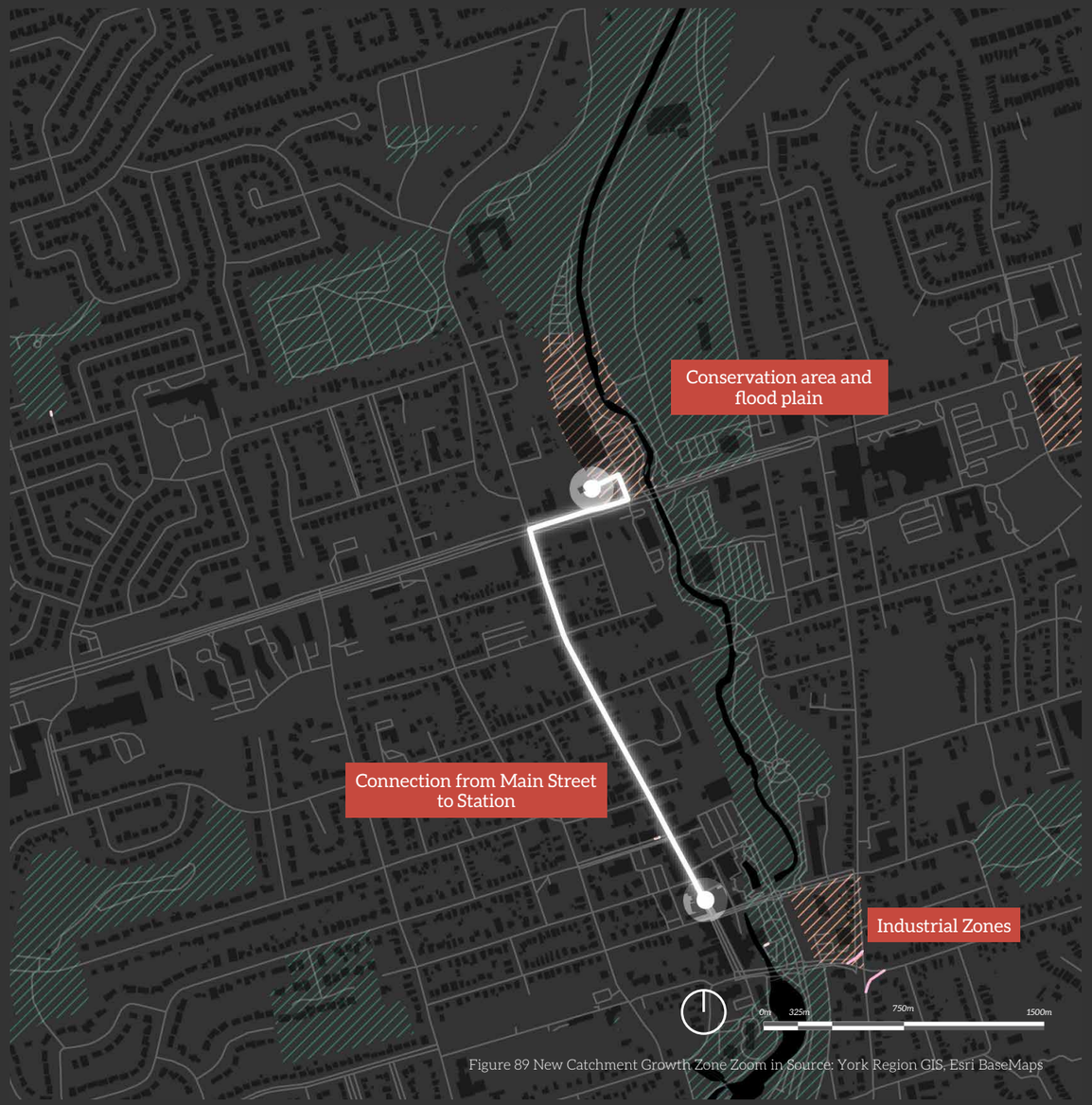


Figure 89 New Catchment Growth Zone Zoom in Source: York Region GIS, Esri BaseMaps

The intent of choosing growth centres abutting main streets is to take avoid developing density within areas that are not walkable to begin with. The GTA's historic centres have an older street pattern, with a high density of intersections, short block lengths, and a mix of uses occupied by local retail. To the east is the conservation area with connection to trails and the ravine network. Currently industrial and mono-functional commercial plots occupy the surrounding station. The intent of the development is to rebuild vacant plots and these mono-functional land uses into a walkable mixed use community.

Legend

- Network Analysis Path
- Transit Stations
- Industrial
- Park
- Buildings

Major Transit Stations Historic Main Streets, Industrial Areas, Natural Systems

Conservation area and flood plain

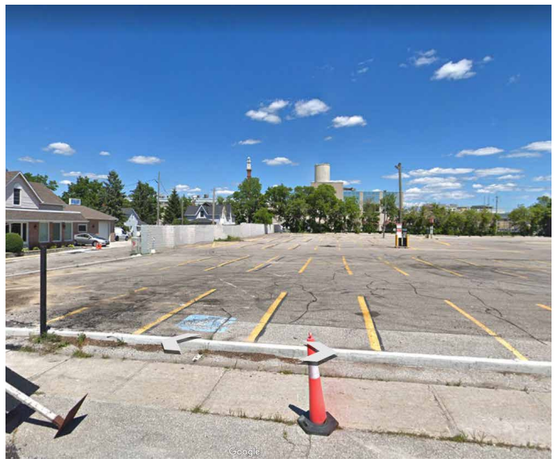
Rail Line

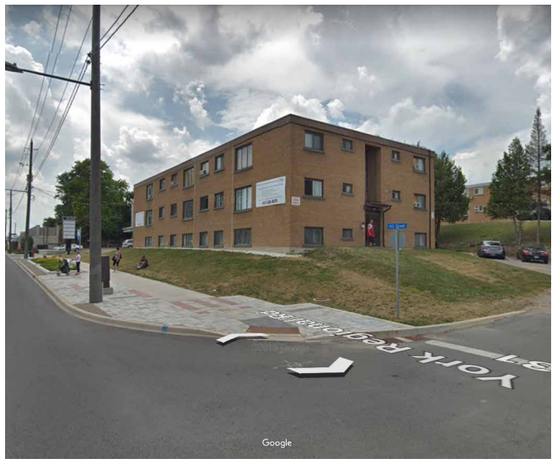
Station

Main Street

Conservation area and flood plain

Surrounding Context





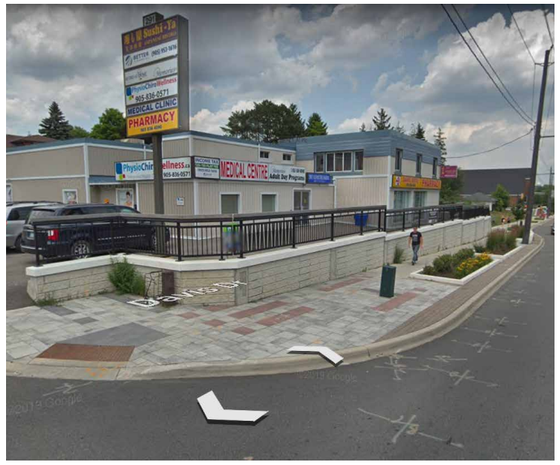
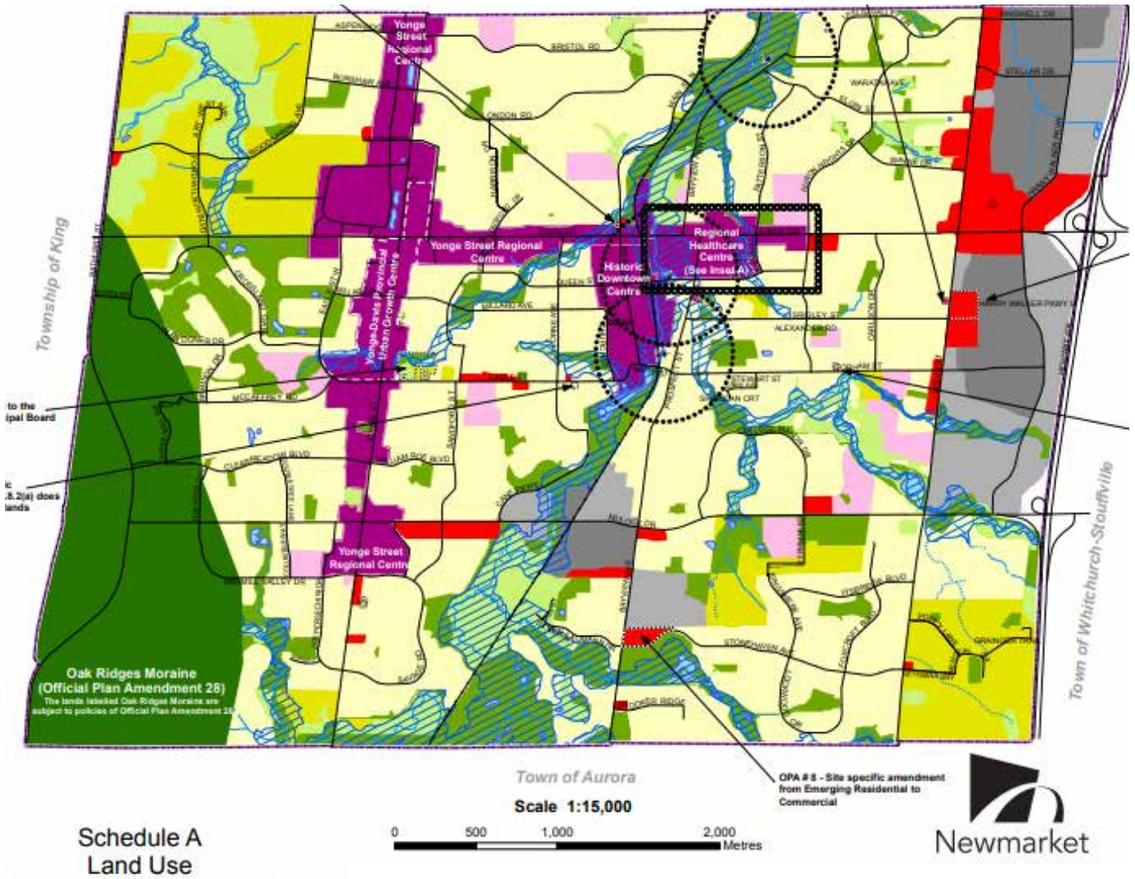


Figure 90 Street View Images Newmarket Source: Google Street View

Newmarket Planning Context



Schedule A
Land Use
Town of Newmarket

- Stable Residential
- Emerging Residential
- Major Institutional
- Business Park - General Employment
- Business Park - Mixed Employment
- Commercial
- Urban Centre
- Parks & Open Space
- Natural Heritage System
- Oak Ridges Moraine Area
  The lands labelled Oak Ridges Moraine are subject to policies of Official Plan Amendment 28
- Flood Plain
  Floodplain limits are shown for screening purposes only and may not reflect the most up-to-date data. The LSRCA should be contacted to confirm the actual floodplain limits & to obtain the most up-to-date data. A topographic survey may be required in order to determine the limit of predicted flooding at a specific site.
- Waterbodies
- Watercourse
- Watercourse - Intermittent
- Waste Disposal Assessment Area
- 500m Waste Disposal Area of Influence
- Regional Health Care Centre Inset Map
- Site Specific Amendments/OMB Referrals
- Yonge-Davis Provincial Urban Growth Centre Boundary
- Regional Water Wells
- Municipal Boundary
- Railway
- Roads

Figure 91 Newmarkt Official Plan

Schedule A of the Town of Newmarket's Official Plan shows some of the planning intentions for the area. The plan reveals the existing growth centre, but also the connecting areas of the urban centres. This provides insights that development could eventually connect the historic centre proposal with the yonge street corridor in future phases of growth. One can also see that the historic core is located within the floodplain of the ravine system. This idea of the design is to build upon these area, but also introduce more permeable surfaces than the existing parking and industrial surfaces that are located there currently.

Figure 92 Newmarket Growth Centre Source Google Earth

Existing Connections and Land Uses

Figure 93 Existing Connections and Land Uses

The following diagram shows the existing road connections, trail network, train lines and core main street in the district. The intent of the design will be to connect both side of the rail network to the main street core, as well as the natural trail network to the west.

Proposed Connections and Land Uses

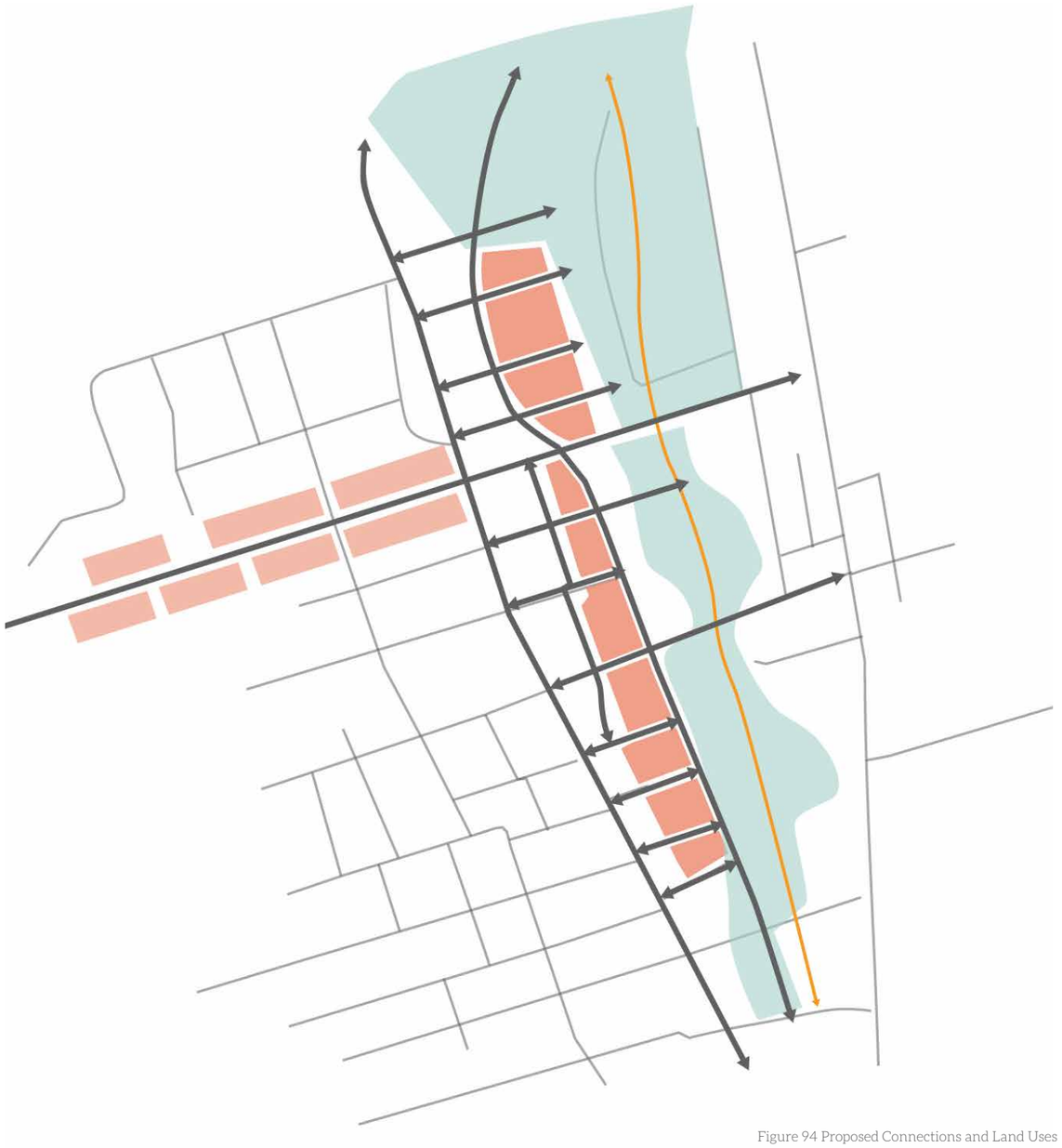


Figure 94 Proposed Connections and Land Uses

This concept diagram reveals the development blocks which draw from the existing street pattern and building fabric within the area. The intention is to increase walkability in the area and create new, internal spaces between streets. Larger development parcels have been left for the density which will be allocated around the primary transit station.

Major Transit Stations Historic Main Streets, Industrial Areas, Natural Systems

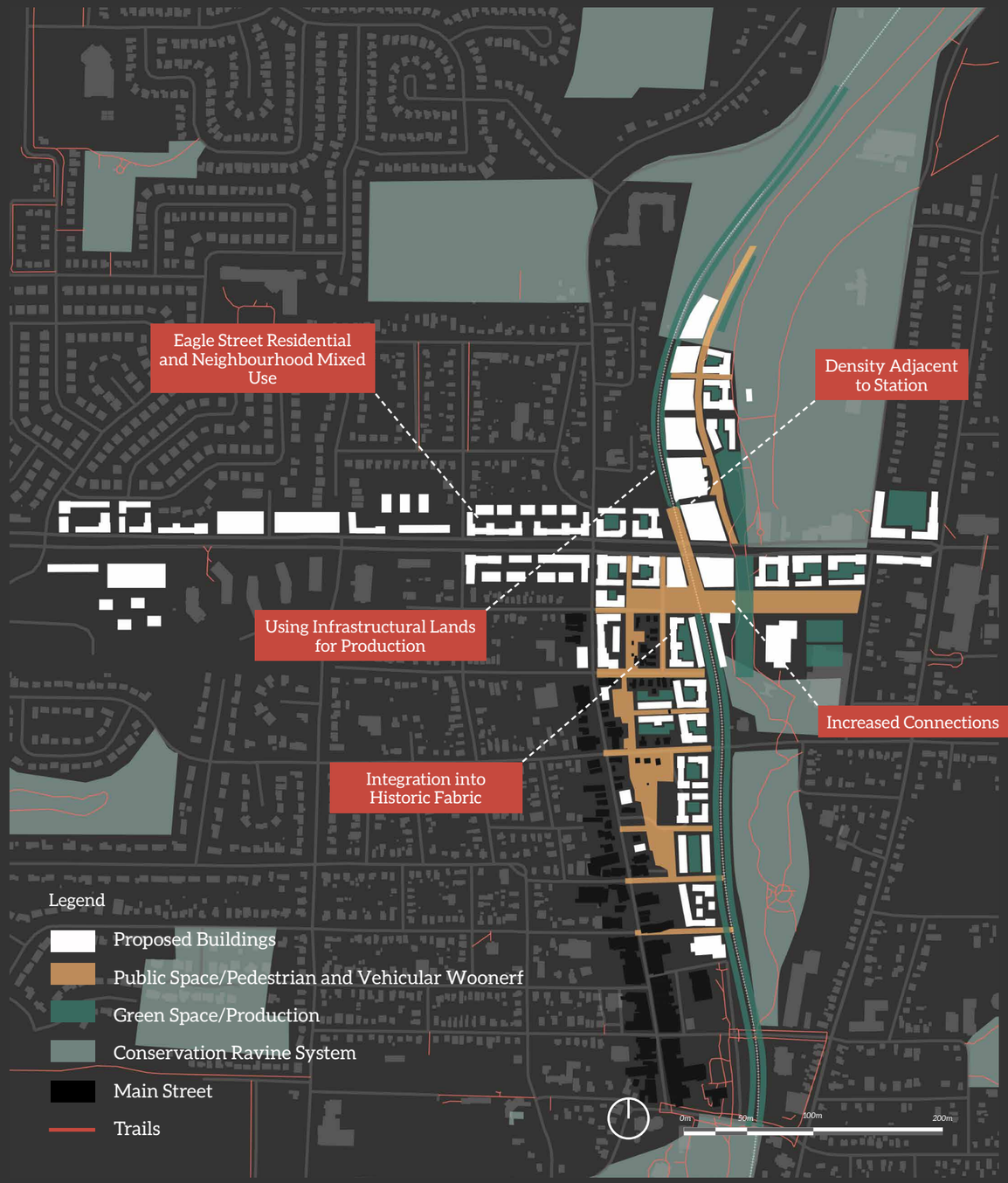
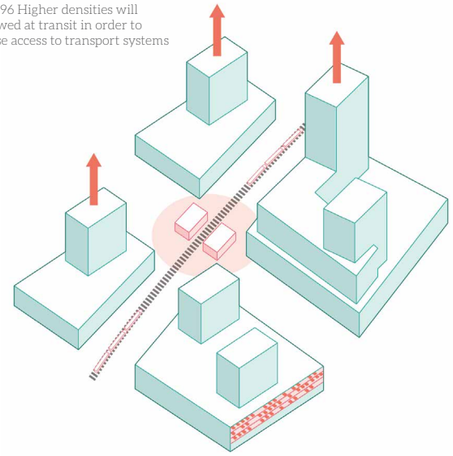


Figure 95 Proposed Plan for Newmarket Main Street

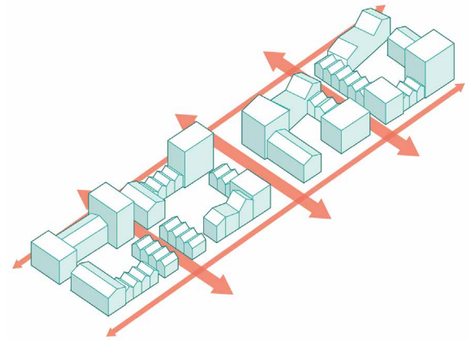
In the following master plan, the street grid is broken up to accommodate walkable areas, internal courtyards, infrastructural buffer lands for energy and food production, and a mix of housing typologies.

Figure 96 Higher densities will be allowed at transit in order to increase access to transport systems



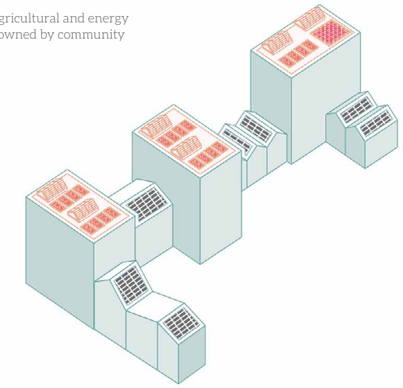
Density Adjacent to Station

Figure 99 The walkable Street Network



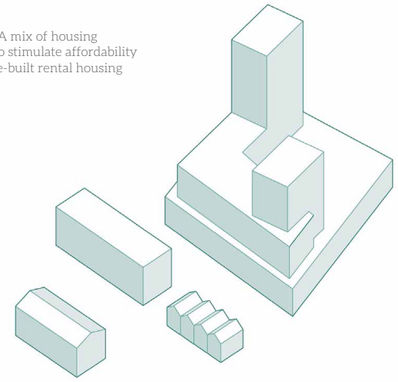
Increased Walkable Connections

Figure 97 Agricultural and energy production owned by community on rooftops



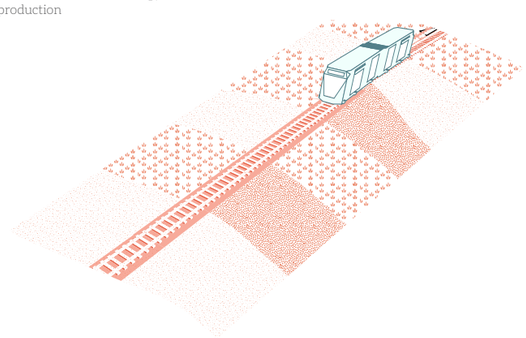
Production Rooftops

Figure 100 A mix of housing typologies to stimulate affordability and purpose-built rental housing



Mixed Housing Types

Figure 98 Buffer areas allowed for food and energy production



Agricultural and Energy Production in buffer lands

Main streets and Walkable Density

The design takes the fabric of the existing main street and builds upon it, sensitively increasing the density and introducing new typologies of housing units into the development. Densities become higher as buildings move closer towards the transit station and closer to the natural trail area to increase access and enhance the views. It is evident that density can be achieved with strategic heights and a finer grain fabric. This type of development has thus far been uncommon within urban intensification, where tall towers generally dominate the landscape.

Figure 101 Proposed Scenario for a Walkable Main Street

10.5 Conclusions

General

The proposed development was able to achieve a (somewhat) realistic development vision and obtain many of the strategies and goals set out within urban intensification. When comparing this area in terms of sustainability and livability comparatively to the existing growth centre currently abutting mono-functional, auto-oriented neighbourhoods, it seems an obvious choice for density. Yet the design would struggle with approvals due to historic preservation and with questions of reducing the attention in the central core downtown and bringing new retail into mixed use buildings.

Food

Production: Food production within the design is fairly limited. The production takes place upon rooftops and within buffer landscapes meaning this small scale production would focus on community gardens led by community initiatives and programs. These programs can offer a source of social cohesion and integration, but the actual production of food will become less significant. This does not pose a large problem for the design, as the area did not convert any agricultural land within its development, creating less of a need to replace the bioproductivity which it had replaced.

Distribution: Currently most main streets are run by BIAs (business improvement association) which requires local retail and food outlets to be located within the main street shops. Local restaurants and grocery stores have a greater ability to use locally sourced produce and livestock than larger grocery stores. The density abutting this local retail core will only strengthen these businesses adn stimulate the local economy in food and other aspects.

Consumption: Within urban intensification, the goal is to create access to local food consumption. As previously stated, the access to local food stores and seasonal community gardens provide opportunities for more sustainable consumption.

Mobility

Walkability: This design for Newmarket's downtown creates a greater ease of access for pedestrians and cyclists using a higher density of intersections and increasing access to amenities and services. A higher amount of pedestrian intersections can be measured within the new development, comparatively to the current conditions of apartment developments in the GTA

Transit Access : Density is focused in close proximity to transit, as well as the entire development being within a 15 minute walk to the GO transit station.

Energy

Production: Similar to food production, energy production is capable of taking place upon rooftops and in buffer landscapes. These lands a perhaps not significant enough to supply electricity/heat for all units, but they may provide some remediation from energy consumption in the area.

Consumption: A mix of housing typologies allows for lowered energy usage and more compact development allows less infrastructure needed in the area.

Resiliency and Regional Affordability: This design for urban intensification (other than a small amount of production) does not offer solutions for resiliency and regional affordability.

Ecosystem Services

Water Supply, Quality, and Soil Retention: This design is intended to add amounts of permeable surface to the existing industrial area which is there currently. This will likely decrease urban water runoff and create possibilities for water recapturing and water reuse within buildings.

Habitat : Considering this is an urban area, the design will likely not introduce significant habitats, other than for small mammals and insects.

Recreation : Density is focused in close proximity to the ravine network which contains many trails connecting through the GTA. The new development would create a larger amount of access per capita, specifically in comparison to the existing growth centre.

Atmospheric Regulation : Ideally the development would benefit atmospheric regulation due to the focus on plantings and the lack of land use conversion needed for development.

Livability

In addition to the steps made toward livability within the strategies for food, mobility housing and ecosystem services, livability has also been improved through increased walkability, increased access to multi-modal transport, and increased recreational/cultural natural amenities. The strategic increases in density allow for the ability to have a higher percentage requirement for rental housing and mixed income housing units.

What Does This Mean for Regional Planning?

From the analysis and the developed scenario, it is evident that far more can be done to select the location of Growth Centres to focus on more sustainable development practices. Yet it is also evident that growth centres are not enough. As the analysis has revealed, though urban intensification has not performed ideally, the reduction of Inner Ring Expansion must be of higher priorities. The process of assessing lands for growth must consider more transitional areas other than the growth centres. Where there are growth centres, these areas should reflect higher goals for sustainability based on the indicators and results noted above. In addition, municipal plans and zoning bylaws must efficiently reflect the goals for a growth plan in a timely manner where development can be instigate through new zoning allowances in urban areas. More can be found on the impacts in the recommendations section.

Figure 102 Main Street Impression

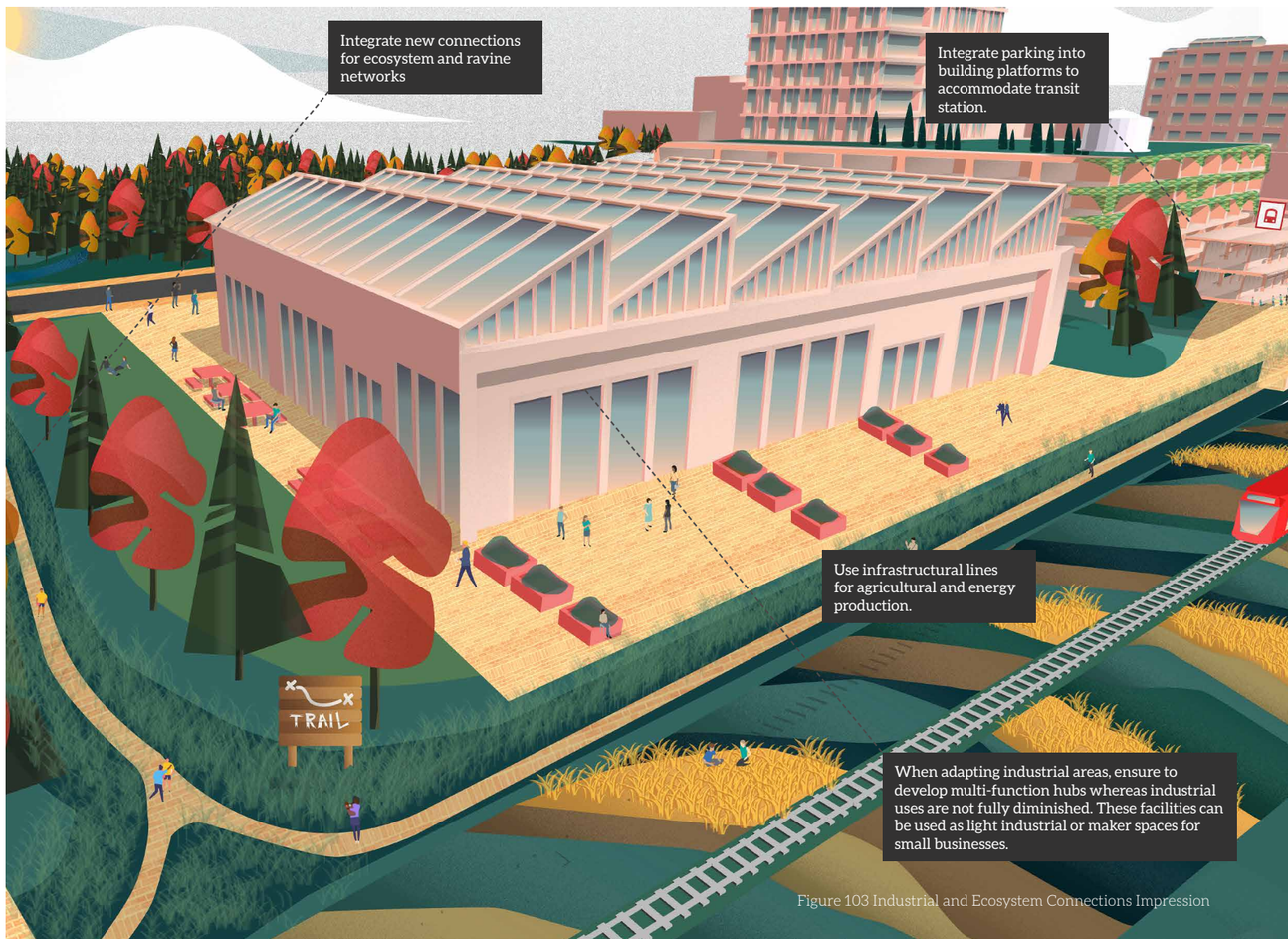
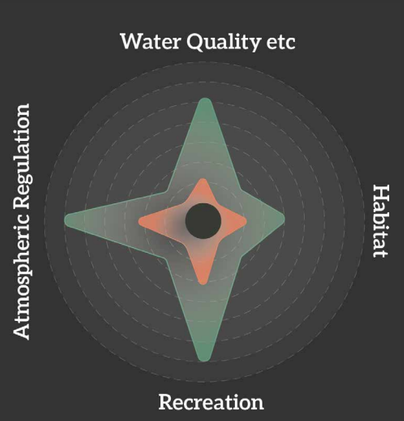


Figure 103 Industrial and Ecosystem Connections Impression

11.0 Developing Strategies from Opportunities for Inner Ring Expansion

The following opportunities are collected from the analysis of each theme for Inner Ring Expansion. These opportunities are to be integrated into Spatial Strategies below.



Ecosystem Services

Water Quality, Supply & Soil Retention: When considering water quality, supply and retention in future development, it is vital to increase the existing floodplain to take existing and future pressure off of the ravine system. Inner Ring Developments should also limit the amount of hard-scaping in development, including an increased around of road infrastructure per person in developments.

Habitat: By creating more compact developments in the inner ring, non-urban forest will continue to remain 'non-urban' with less visitors and less impact from the adjacent suburban system.

Recreation: By increasing walkability and East-west connections in developments, inner ring expansion could highlight the natural services which surround these neighbourhoods, rather than limiting accessibility to directly adjacent neighbourhoods and by car access.

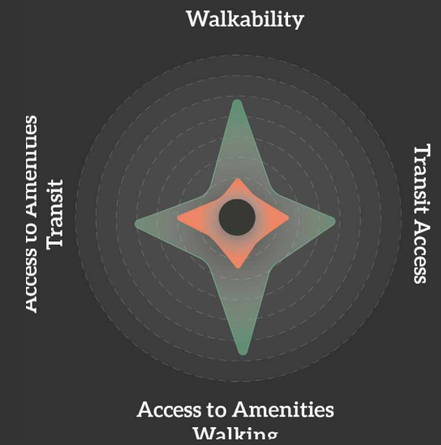
Atmospheric Regulation: Extending the 100 year flood plain will extend the forested lands and wetlands which will improve atmosphere regulation.

Energy

Production: Inner Ring Expansion provides opportunities for new, better infrastructure due to the lowered costs of construction in greenfield development. New developments have the possibility of integrating district heating into developments from the start in order to reduce heating emissions in expansion areas. These areas also have an increased amount of open spaces for small scale wind projects and possible biomass/biogas production for district heating.

Consumption: These developments which are already being built at high densities have the ability to include a new mix of housing typologies which will improve heat loss from building monotonous buildings.

Security and Resilience: By creating new infrastructure systems with a more compact design, the distance of infrastructure will likely decrease, as well as add opportunities for decentralized systems which will resist shocks to the larger high voltage network.



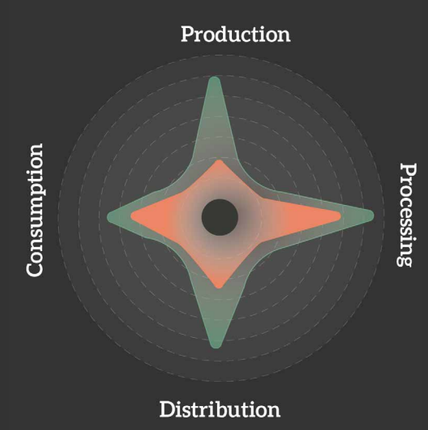
Mobility

Walkability & Automobile Oriented Design: Most of all Inner Ring Expansion and Greenfield development uses subdivision design at recently high densities. Given the densities which these developments are already using, a mix of unit types and street networks can be integrated into the design. Path connections and winterized walking connections (district heating) could be used to incentivise walkability and walkable access.

Transit Access: Developments should focus moderate density along secondary transit lines in order to increase use and avoid the inefficiencies existing in subdivision development.

Access to Amenities by Walking: By integrating new building typologies and strategic density on transit access ways, developments can also target areas for mixed use buildings. These areas can increase the exposure to amenities during walking trips/

Access to Amenities by Transit: Access to transit could increase with increased mixed use types and increased access to secondary transit.



Food

Production: The Inner Ring contains development which will take place on high-quality farmland. There is an opportunity to integrate this farmland into developments in order for farmers to rent the remaining land to increase their land mass. Land renting after a developer buys land is already a common process in the GTA. These lands have the opportunity to continue producing local demand foods in the region, with less of a travel distance to local stores.

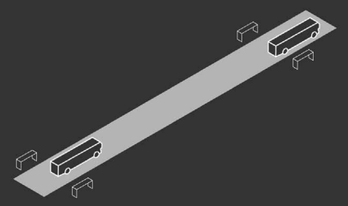
Processing: Most processing plants are located closer to the urban industrial areas more central in the region.

Distribution: Inner Ring Expansion has the opportunity to change the way which people access food. This can be done with targeted building density and mixed use communities which provide walkable access to grocery stores.

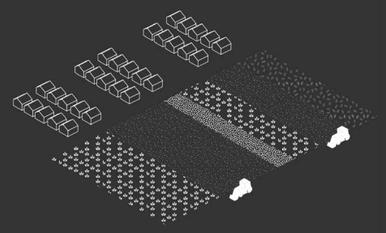
Consumption: Based on the indicators analysis consumption was the highest in inner ring expansion. This due to higher incomes, an expanding density in new areas, and of course the age of inhabitants. The focus of consumption in the realm of urban planning should be having access to affordable and local food in order to lower ecological footprint. In order to improve the issue of consumption and waste, there must be education programs and incentives for consuming less and wasting less food.

11.1 Inner Ring Expansion: Existing Spatial Conditions

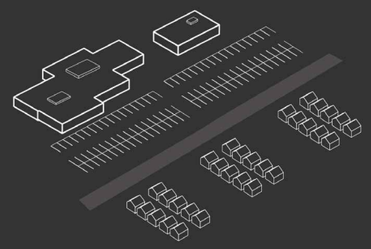
Based on the opportunities within the analysis of Inner Ring Expansion, strategies must be developed in order to implement these possibilities in order to change sustainability indicators for future growth. The following is a summary of the generic spatial conditions which are found within areas of IRE within the built boundary. These spatial conditions are both vital nodes for the community, and also parcels and lots which are opportunities for redevelopment such as monotonous commercial and industrial lands. Additionally, the strategies for Inner Ring Expansion also address changes to the traditional subdivision designs which are familiar to these areas.



Secondary Transit Lines and Stops

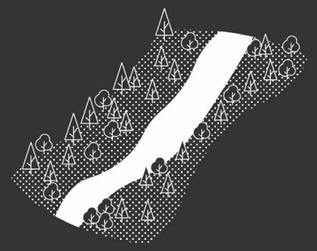


Agricultural Land for Greenfield Development

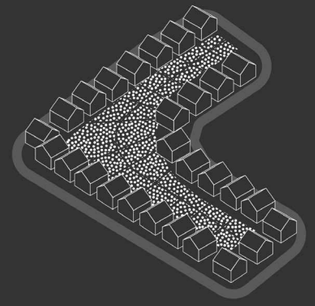


Mono-functional Surrounding Land Uses

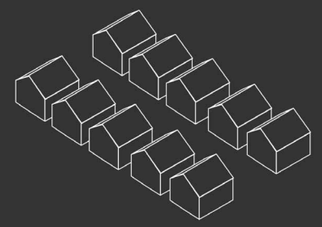
North-South Trail Networks



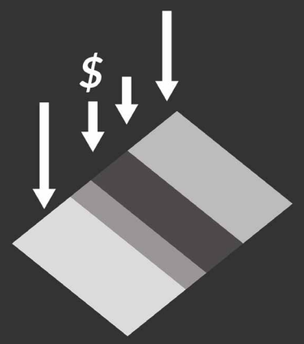
Adjacent Wetlands & Urban Forests



Common Practice of Private Yard Space



Primarily Owned Homes

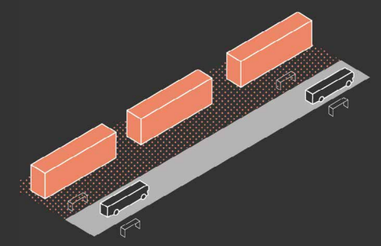


Reduced Land Price

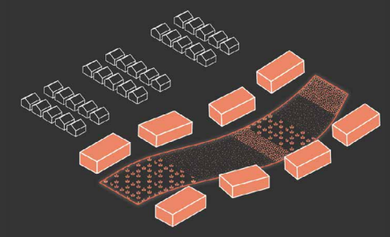
Vehicular Oriented Street Networks

11.2 Inner Ring Expansion: Potential Spatial Strategies

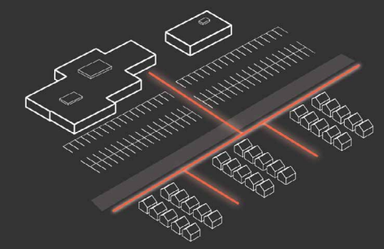
The following is the integration of our opportunities and spatial conditions for the region. These result in strategies which aim to combat the largest issues associated with the Inner Ring.



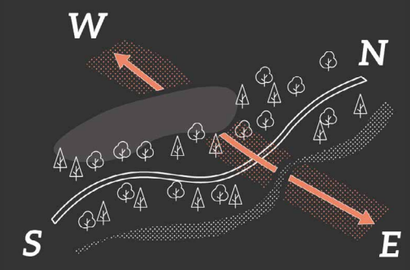
Higher Density at Secondary Transit Lines



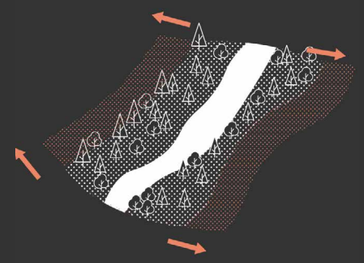
Preserving Connected Agricultural Lands



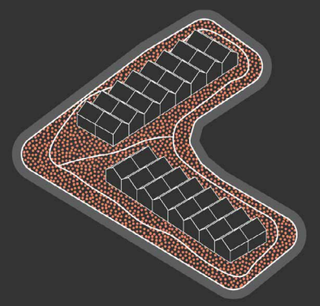
Use Residual Heating and District Heating Opportunities



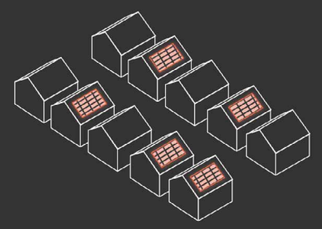
Connect North-South Trail Networks



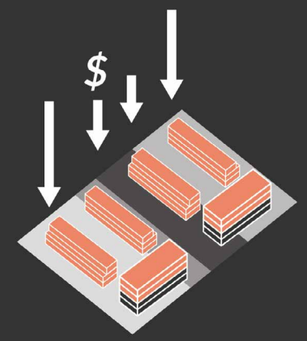
Extend the 100 year flood plain



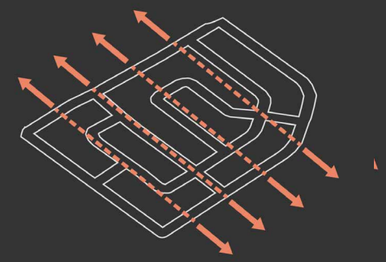
Back yards to public spaces



Ownership Opportunities for Energy



Introduce mixed income, and mixed use housing using density bonuses to promote affordability



Create new connections which enhance walkability

12.0 'What if' Scenarios: Inner Ring Expansion

In order to base regional recommendations off of the strategies proposed in the previous section, the next phase of the project will generate 'What if' scenarios. Through these scenarios the study will integrate some of the proposed strategies. Using the scenario as a test, the resulting conclusions and design will provide a more thorough understanding on the realities of developing these strategies in the Whitebelt context. The following what if scenarios targets three strategies created for Inner Ring Expansion and combines them in order to test the possibilities for development.

Inner Ring Expansion

Existing Spatial Conditions

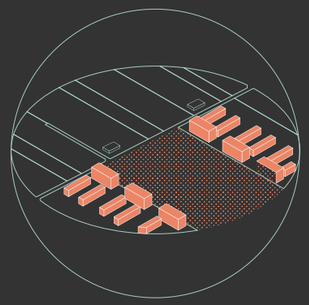
- Secondary Transit Stops and Lines
- Trail Networks
- Local Food Production Lands
- Residual Heat Opportunities
- Food Waste Facilities
- Low Value Land Costs

+

Proposed Strategies

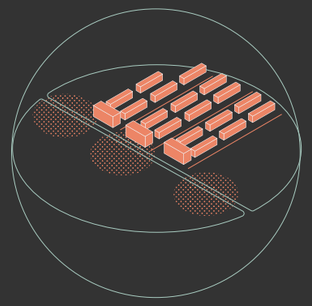
- Density & Transit Stops
- District Heating in New Development
- Rooftop Energy Production
- A Mix of Housing Typologies
- East-West network
- Densify along E.S. networks
- Mixed Use Development
- Integrate Existing Local Food Production Land
- Walkable Routes to Transit
- Develop Outside 200 year floodplain

12.1 What if:



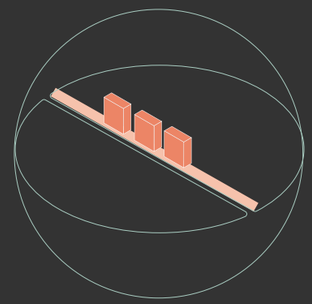
Inner Ring Expansion **incorporated existing agricultural land** *into new developments creating a local food production network?*

Though agricultural preservation is a common theme around urban planning, farmers are still (rightfully) able to sell their land when necessary, or when the prices have increased. Can these recently purchased lands have partly preserved agricultural lands which then can be rented back to farmers? In the GTA, agricultural land rental is a common practice before the land is developed, why not after?



Inner Ring Expansion used **district heating to incentivise walkabillity** *to transit in winter?*

Access to transit is a large problem within inner ring expansion due to the auto-mobile oriented subdivision design. This is especially worsened in the winter months. Can designs promote moderate density along secondary transit systems and also integrate district heating networks to incentivise walkability to stops in winter?



Inner Ring Expansion increased zoning densities along secondary connector roads if **mixed-use and mixed income units** *are incorporated into these developments?*

The ownership rates within the inner ring expansion is especially high. Can municipalities use zoning bonuses in order to increase heights where a higher percentage of rentership and mixed income housing is included?

12.2 Locating Spatial Parameters

Primary and Secondary Transit, Croplands, Municipalities

In order to locate areas of potential development, this phase of the scenario was to identify croplands t,hat lie within the Whitebelt. These lands were broken into the municipalities which they fall into. The comparison to these lands and the goals for greenfield growth in municipalities is compared in the following section.

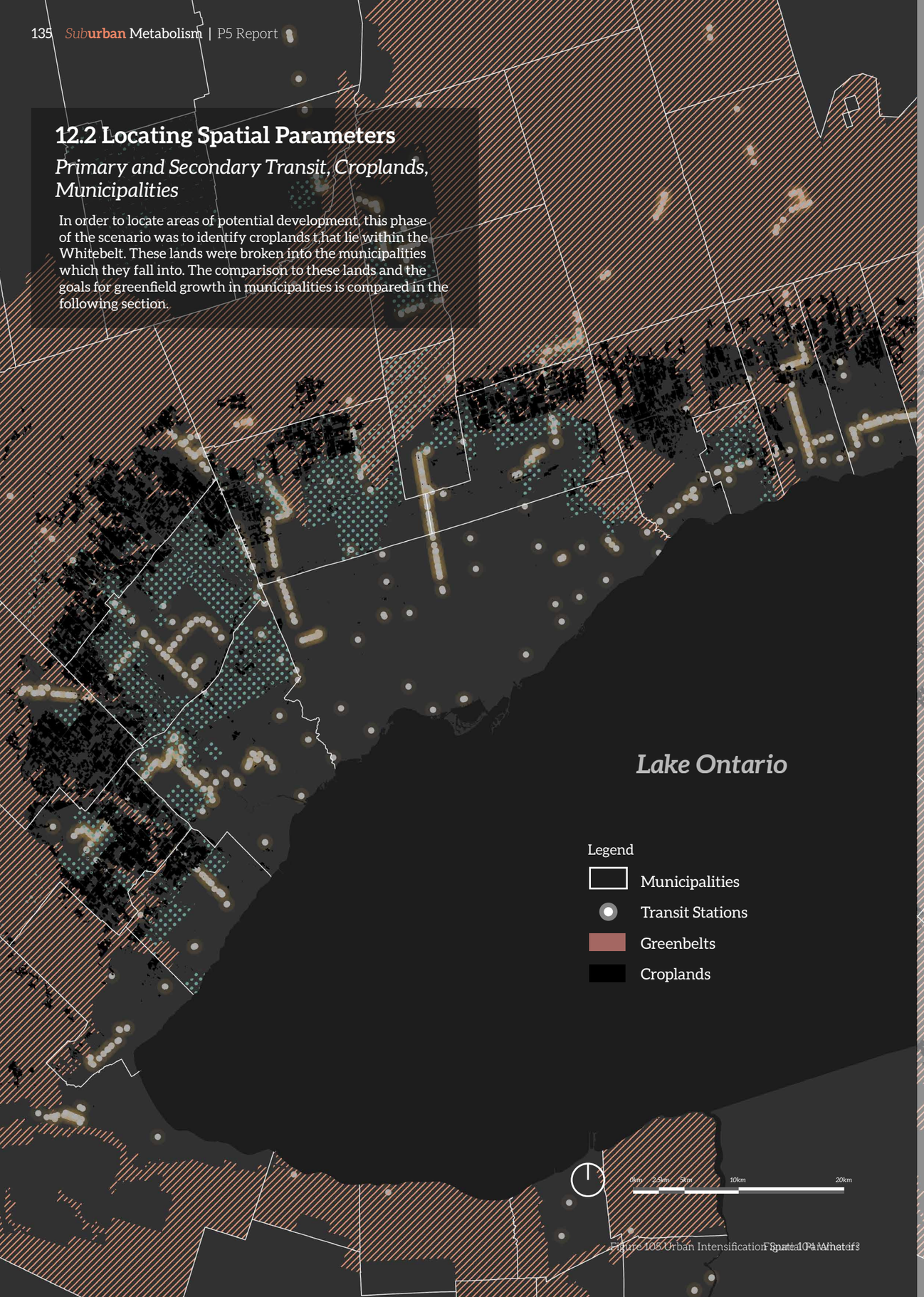


Figure 108 Urban Intensification Spatial Parameters

Figure 107 Urban Intensification Spatial Parameters Selection

12.3 Specified Locations

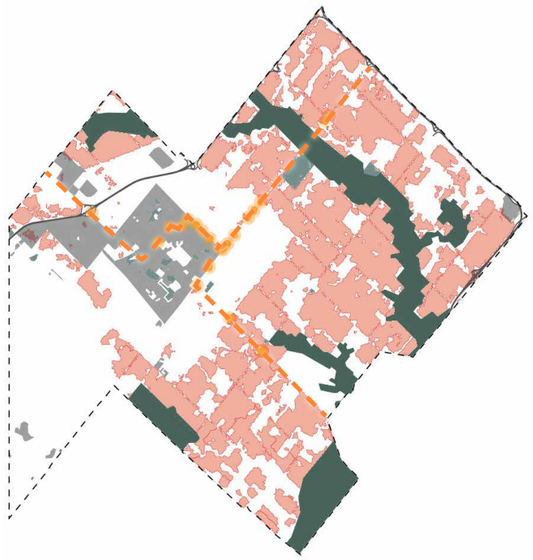
Municipalities with Highest Areas of Croplands and Expansion Growth

Legend

- Greater Toronto
- Transit Stations
- Built Area
- Crop Lands
- Park Lands

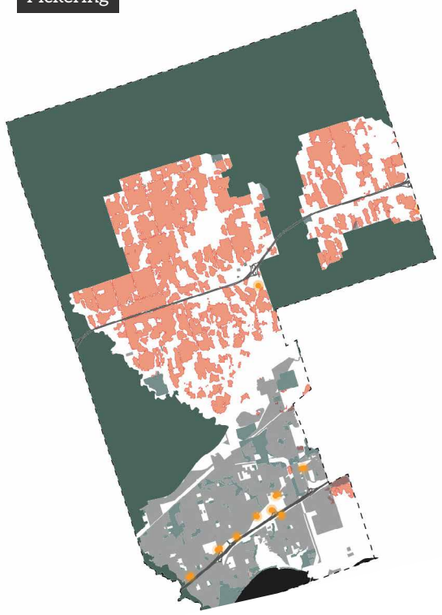
Oakville

Milton

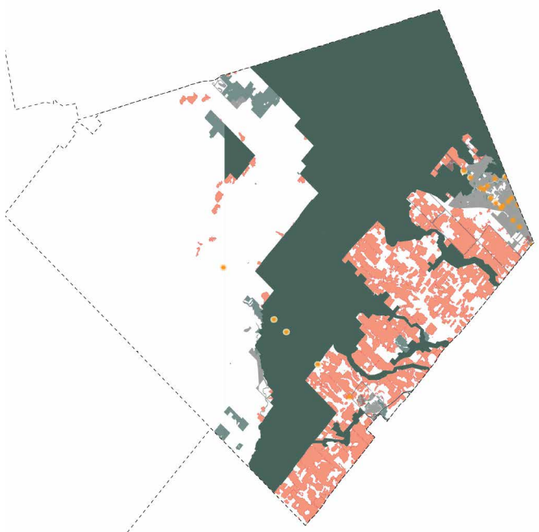


Markham

Pickering

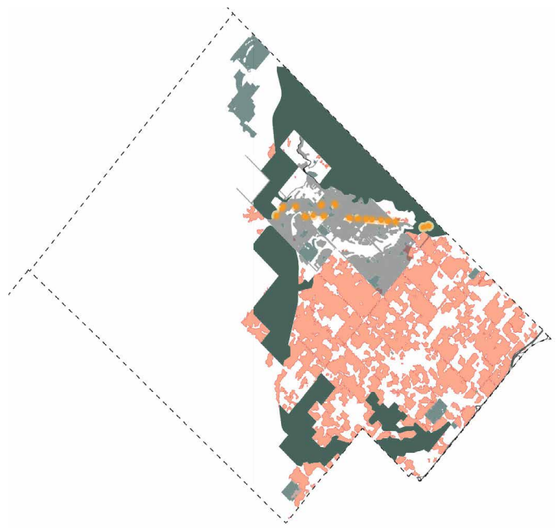


Caledon



Vaughan

Halton Hills



Whitby & Oshawa

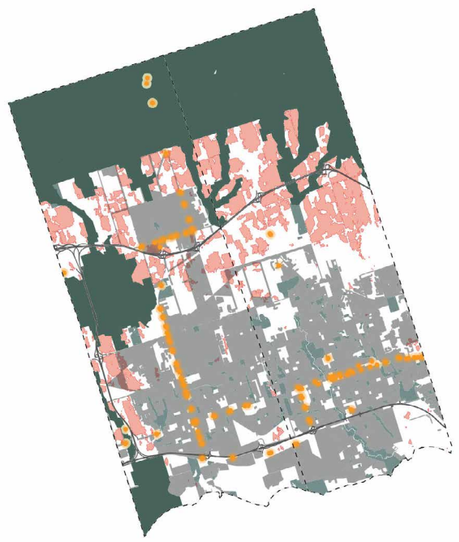
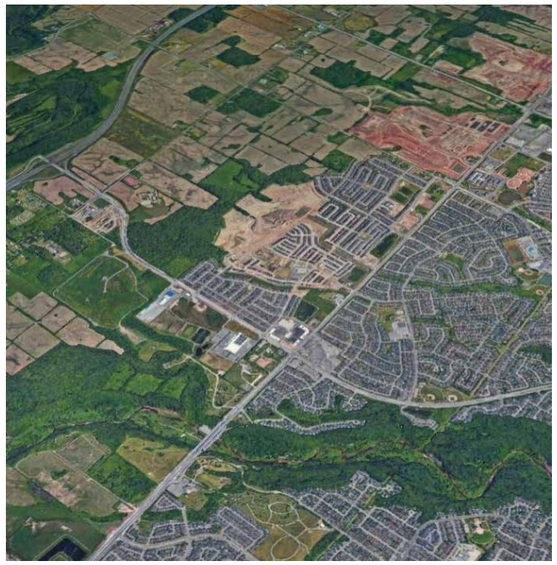


Figure 108 Selected Municipalities Zoom ins Source: GIS Scholars Geoportal and OSM

The Estimated Consumption of Cropland but 2041 Per Municipality

The following are the chosen municipalities based on the spatial parameters. Each municipality is host to a certain area of agricultural lands. These lands are all considered for development and expansion through greenfield development. Using land budgeting and future population projections, these municipalities establish the amount of lands which they will need for greenfield areas. Given the current growth target (not current trend) the area needed to accommodate future growth within greenfields was calculated.



Oakville
Primary Crop: Wheat
Cropland Area: 1,830 ha
2041 Growth: 48,195

40% Growth Target for Greenfield development = 28,917 people

At a density 50 persons per hectare this will = 960 hectares

1,800 ha — *Croplands*

960 ha — *Greenfield Development Projection*

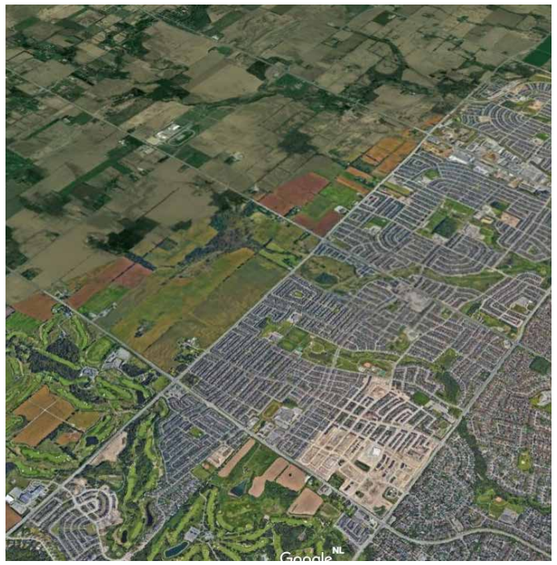
Milton
Primary Crop: Wheat
Cropland Area: 5,064 ha
2041 Growth: 103,439

40% Growth Target for Greenfield development = 62,063 units

At a density 50 persons per hectare this will = 1,200 hectares

5,000 ha — *Croplands*

1,200 ha — *Greenfield Development Projection*



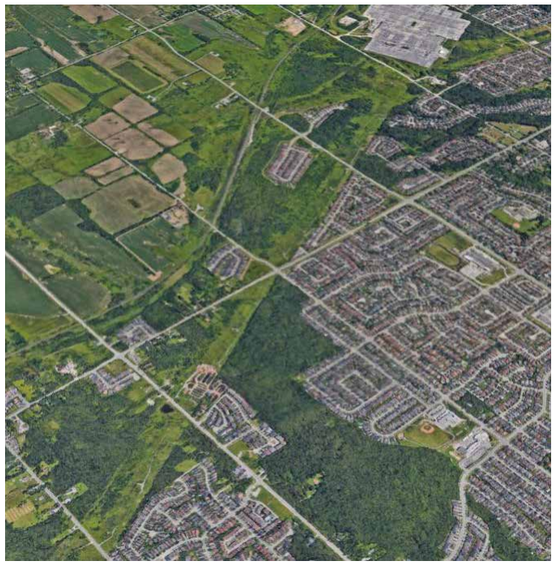
Markham
Primary Crop: Wheat
Cropland Area: 3162 ha
2041 Growth: 78,630

40% Growth Target for Greenfield development = 47,178 units

At a density 50 persons per hectare this will = 964 hectares

3,160 ha — *Croplands*

940 ha — *Greenfield Development Projection*



Pickering
Primary Crop: Wheat
Cropland Area: 4509 ha
2041 Growth: 79,662

40% Growth Target for Greenfield development = 47,797 units

At a density 50 persons per hectare this will = 950 hectares

4,509 ha — *Croplands*

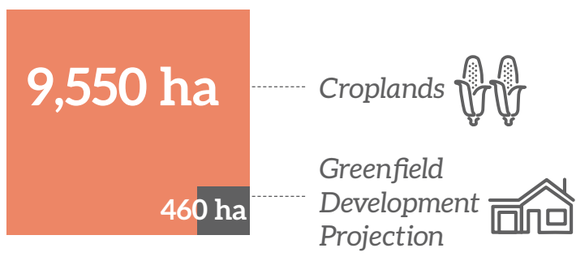
950 ha — *Greenfield Development Projection*

Figure 109 Selected Municipalities Greenfield Projections Source:Unit projections from Places to Grow (2017), Areas for farmland calculated from GIS land cover summary

Caledon
Primary Crop: Wheat
Cropland Area: 9,544 ha
2041 Growth: 36,400

40% Growth Target for Greenfield development = 21,840 units

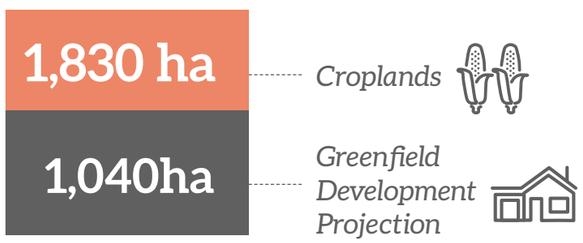
At a density 50 persons per hectare this will = 460 hectares



Vaughan
Primary Crop: Wheat
Cropland Area: 3162 ha
2041 Growth: 86,719

40% Growth Target for Greenfield development = 52,031 units

At a density 50 persons per hectare this will = 1040 hectares



Halton Hills
Primary Crop: Wheat
Cropland Area: 4922 ha
2041 Growth: 30,725

40% Growth Target for Greenfield development = 18,435 units

At a density 50 persons per hectare this will = 370 hectares

Whitby & Oshawa
Primary Crop: Wheat
Cropland Area: 4519 ha
2041 Growth: 95,483

40% Growth Target for Greenfield development = 28,917 units

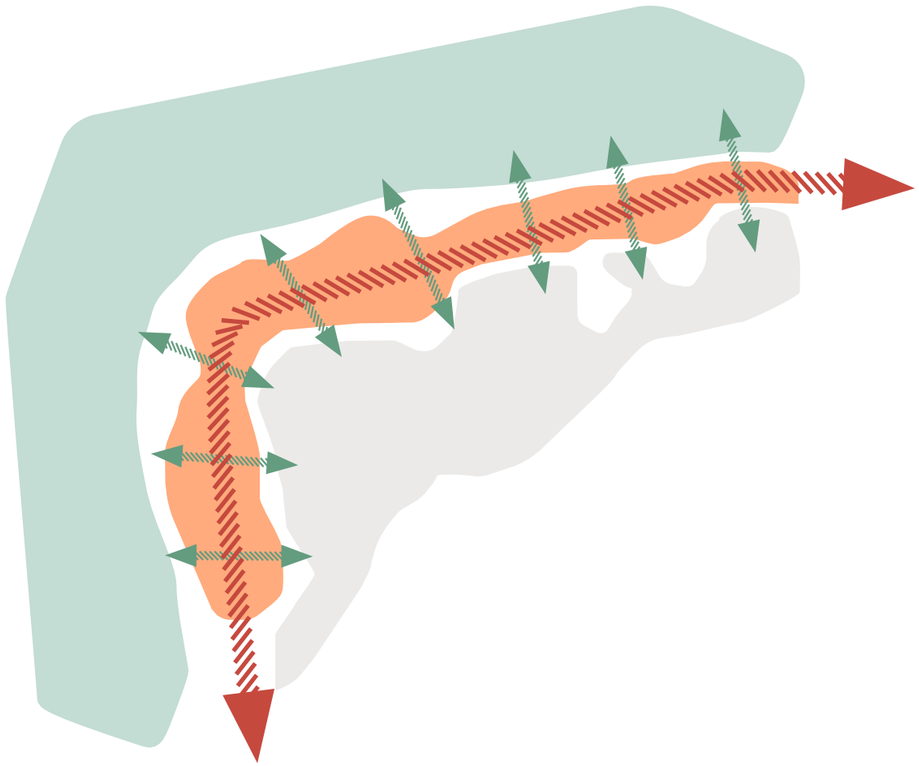
At a density 50 persons per hectare this will = 964 hectares

Potential Agricultural Land Conversion

Given the general analysis of these municipalities and their projections, even with the growth plan, 12,000 hectares of local farmland could be developed. Considering the existing trends of the region, this could be doubled by 2041.

12,000 hectares
of total Greenfield could be developed by 2041 **25% of Agricultural land in the GTA considering the growth targets**

24,000 hectares
of total Greenfield could be developed by 2041
50% of Agricultural land in the GTA considering the current practices



Can a ring of agricultural land be preserved through:

Land Use designations:
Protecting Agricultural Areas
+
Zoning Requirements:
for the integration of local production in new development

12.4 Milton Ontario

Potential Growth Within the Municipality

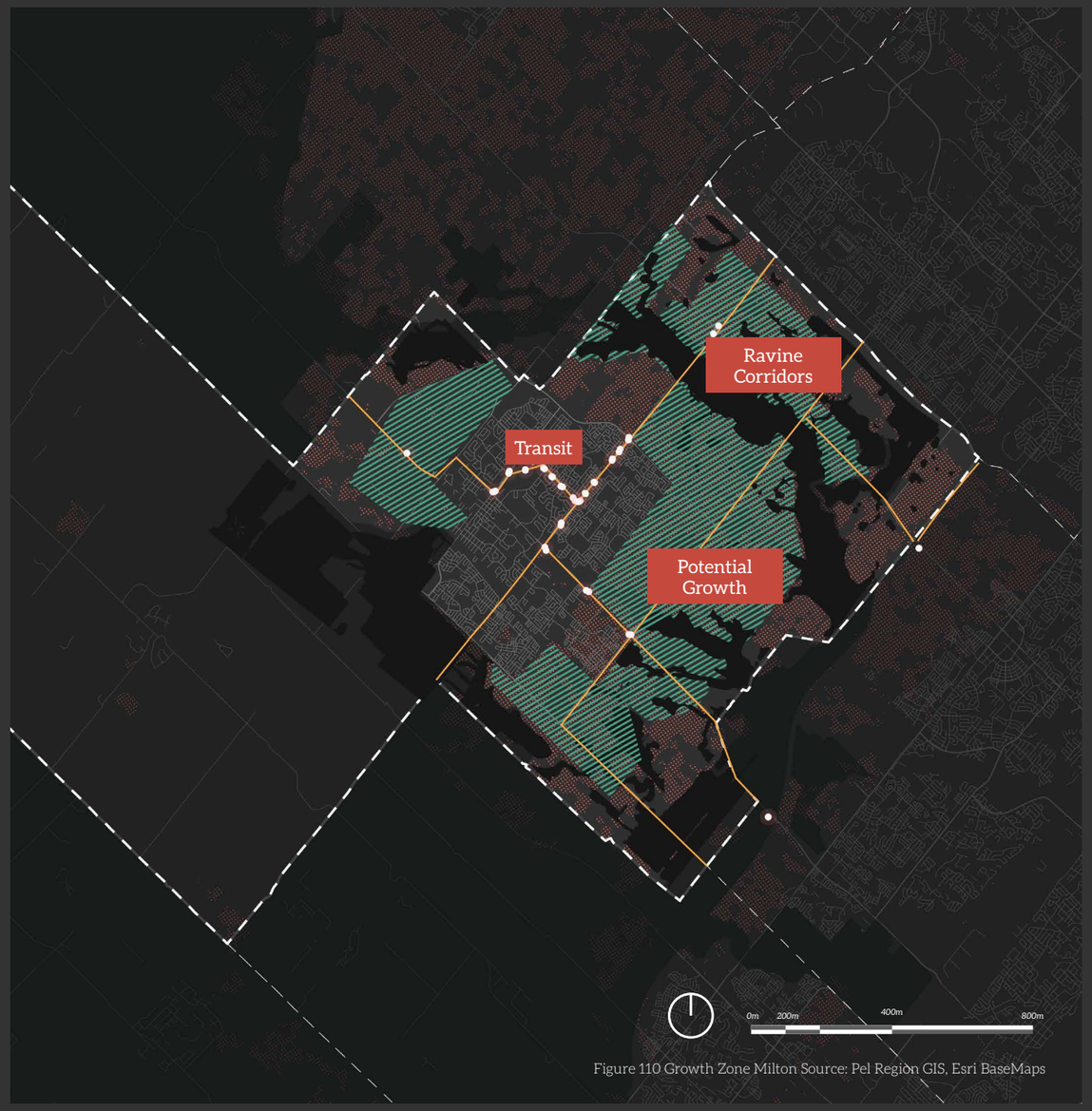


Figure 110 Growth Zone Milton Source: Pel Region GIS, Esri BaseMaps

Milton has been chosen for the project location considering the rapid rate of expansion within the municipality and its large amounts of greenfield development space. As one can see in the map above, Milton has the potential of expanding into these existing agricultural areas.

Legend

- Municipalities
- Transit Stations
- Growth Poternial
- Crop Land
- Green Belt

1200 Hectares of Projected Growth (Selected)

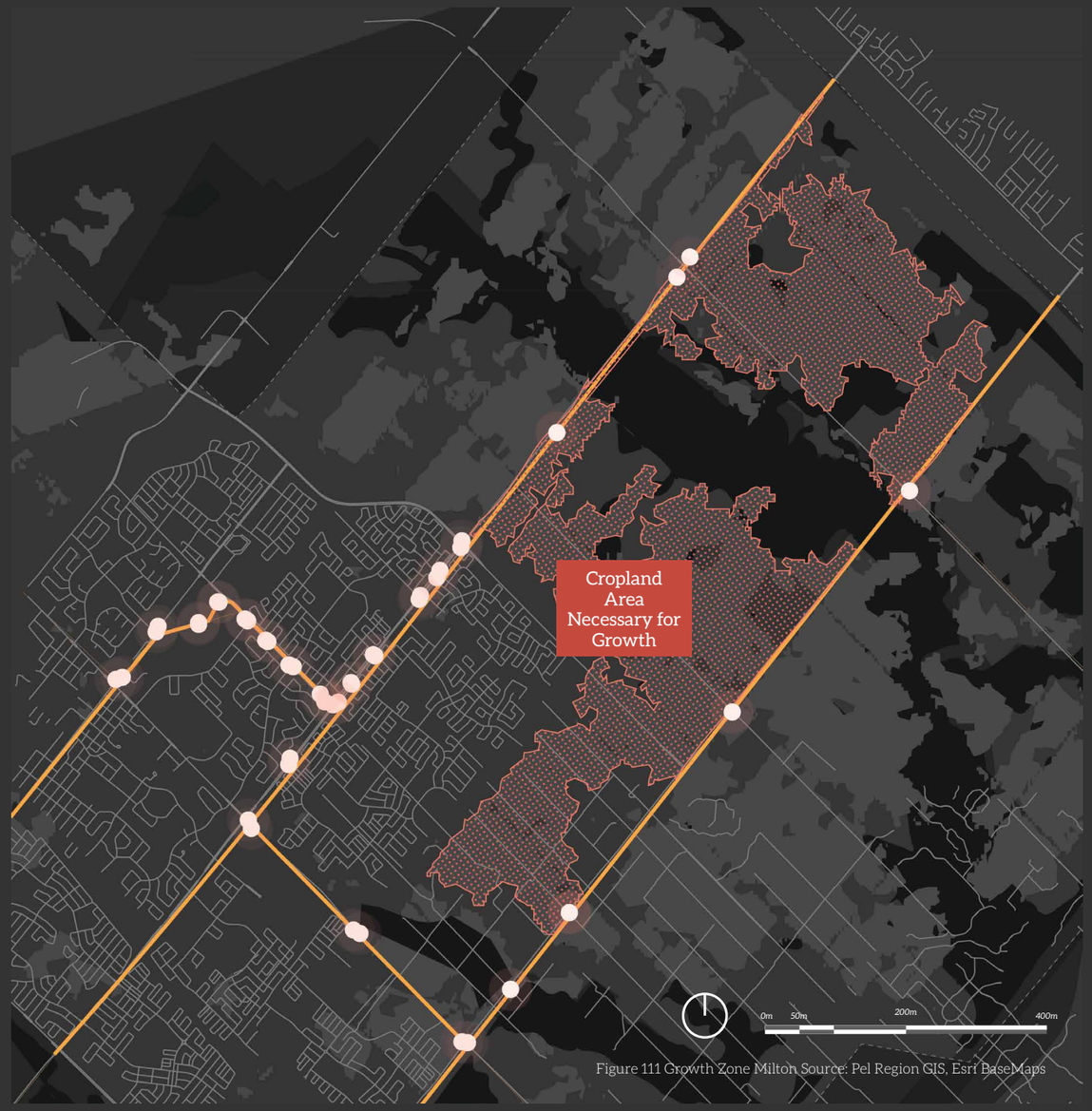
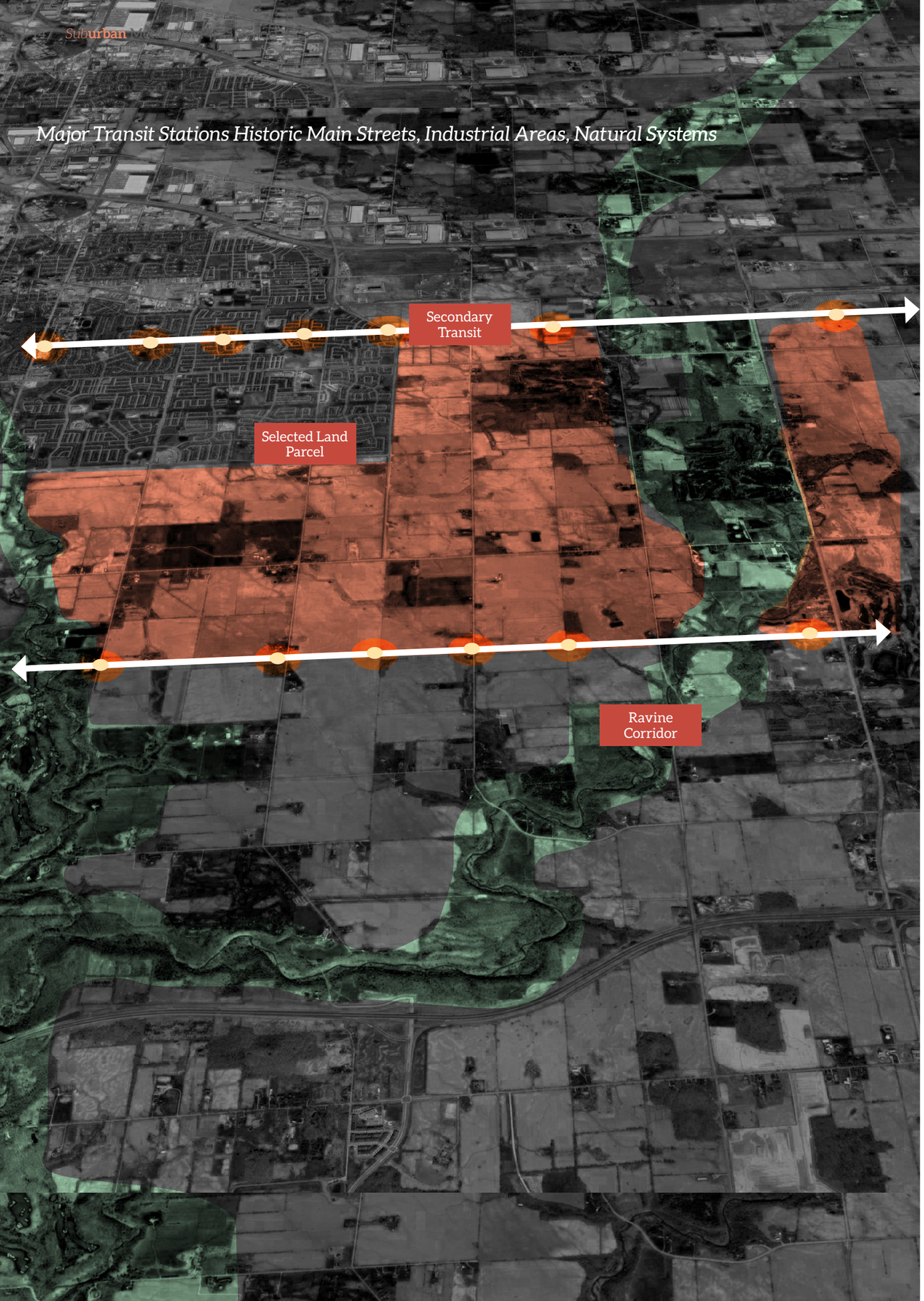


Figure 111 Growth Zone Milton Source: Pel Region GIS, Esri BaseMaps

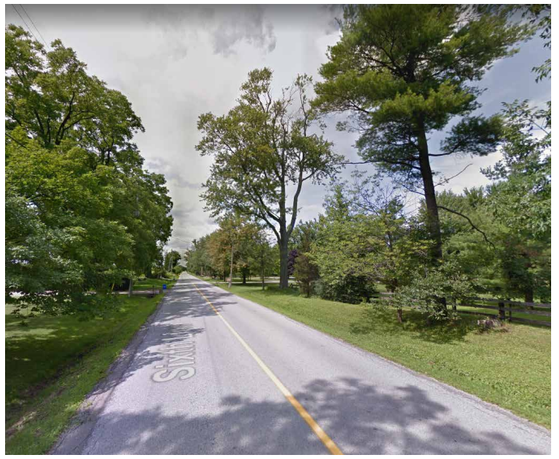
To test the idea of the agricultural ring, targeted secondary transit, and increased ownership, the project area was chosen as several agricultural plots located between two secondary transit lines. This agricultural strip connects two ravine corridors which contain connecting trails to other municipalities.

Legend

- Municipalities
- Transit Stations
- Selected Crop Land
- Green Belt



12.5 Milton Context Images



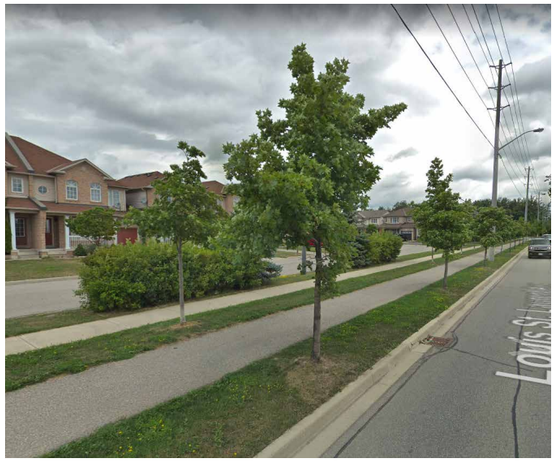


Figure 112 Google Street Images Milton Source Google

Milton Planning Context

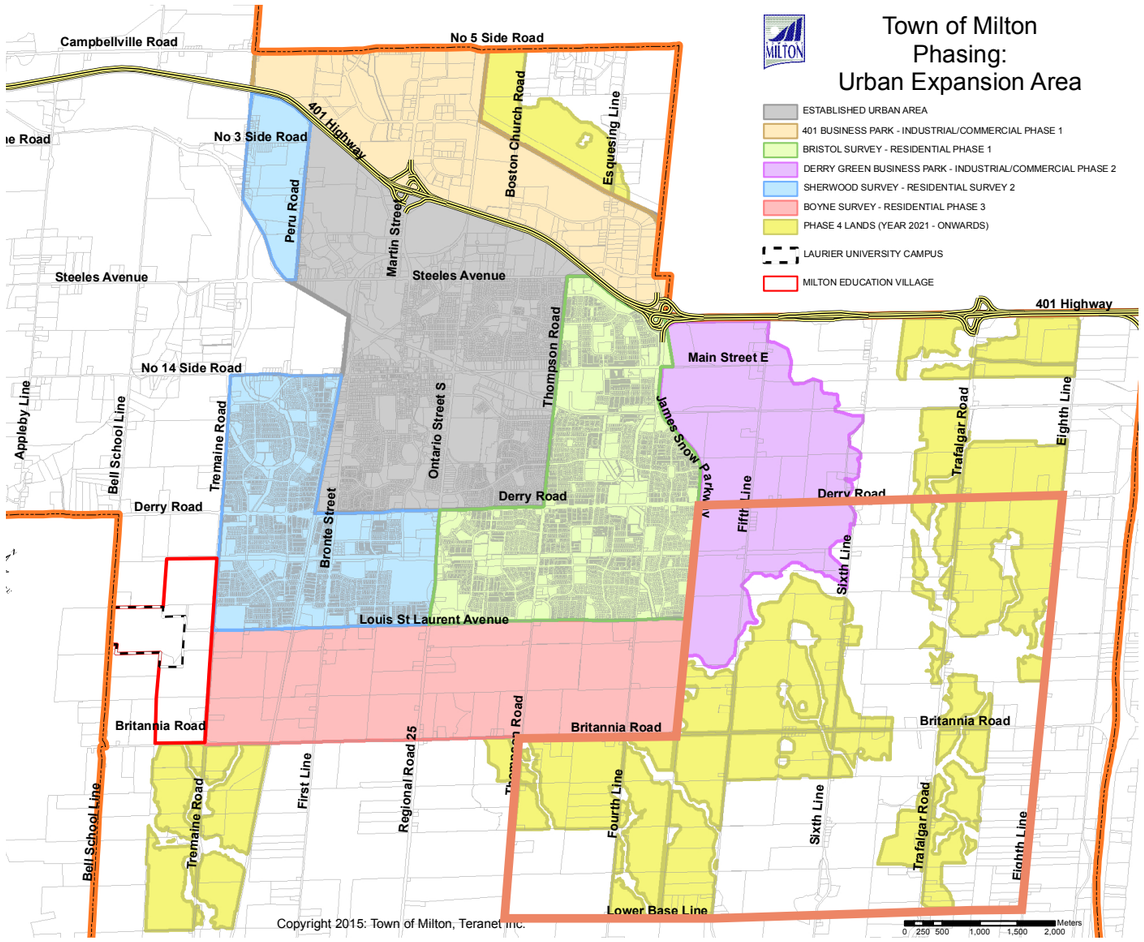


Figure 113 Bradford Official Plan

In Milton's Official Plan they have designated the urban expansion areas for the next several years. The subject area is part of the phase 4 residential lands, as well as the proposed business park located to the north-east of the current built boundary. It is evident that these large swaths of lands are extending an already fast growing community.

Figure 114 Downtown Milton Source: Stephen Hayes Photography

Existing Land Uses and Connections

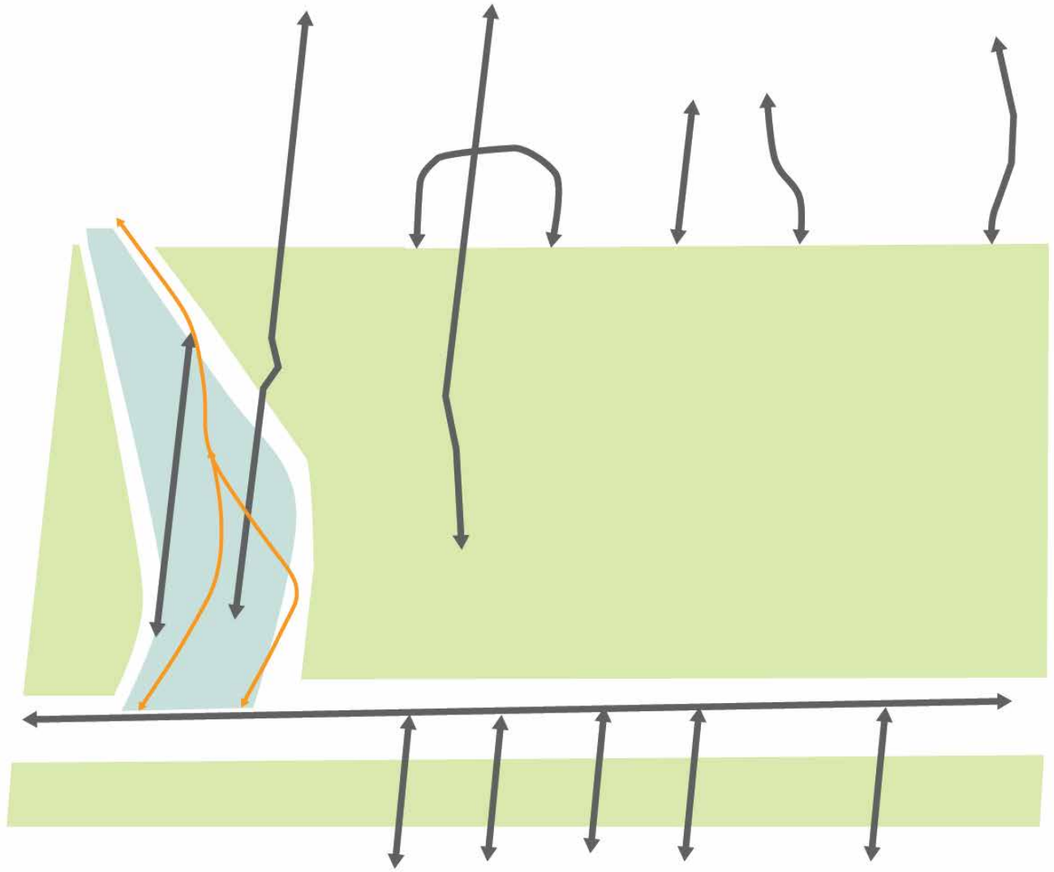


Figure 115 Existing Land Uses and Connections

The current lands are agricultural uses with an understandable lack of connector roads. To the west of the parcel is ravine corridors. To the north of the site, is existing monotonous residential lands.

Proposed Land Uses and Connections

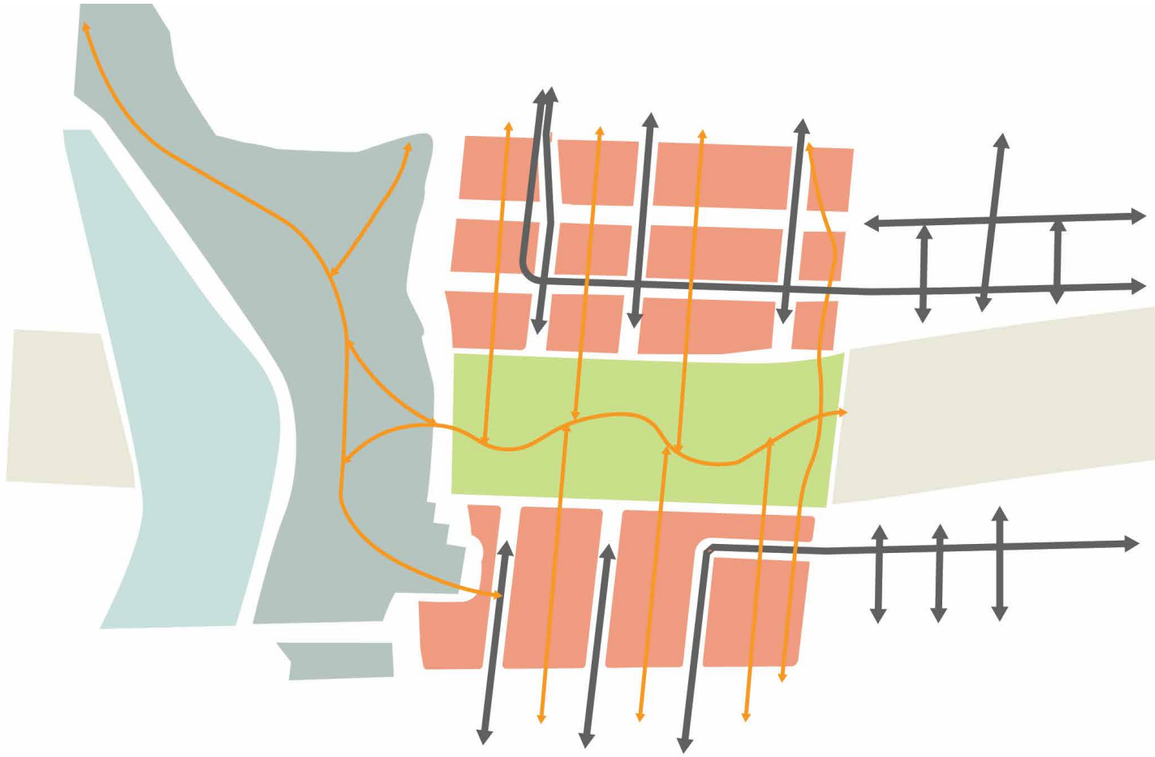
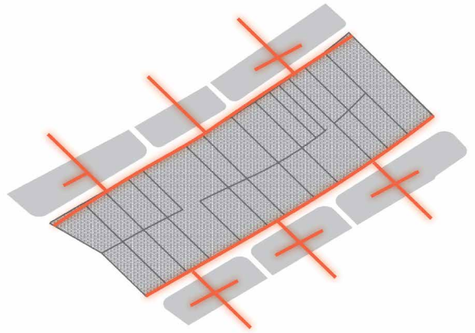


Figure 116 Proposed Land Uses and Connections

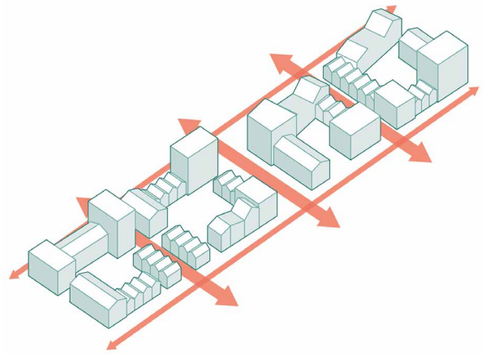
In the proposed concept, the ecosystem/ravine corridor is extended to account for the new floodplain sensitivities in the region. The built form introduces new road connections through the site, but more importantly include a pedestrian grid into the plots. A central section of the design has been take as the land for local agricultural practices which can be rented after development.

Selected Parcel of Agricultural Ring Design

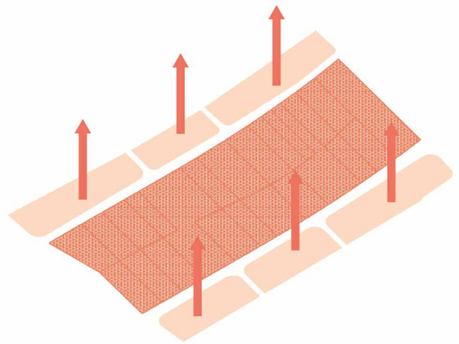
Figure 117 Proposed Master Plan for Inner Ring Scenario



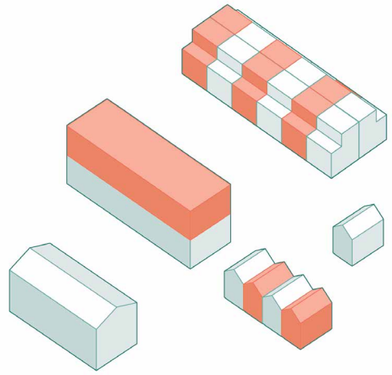
District Heating to incentivise walkability



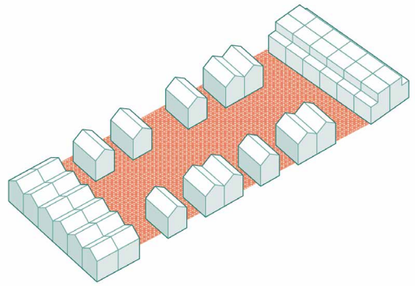
Walkable Grid Connections



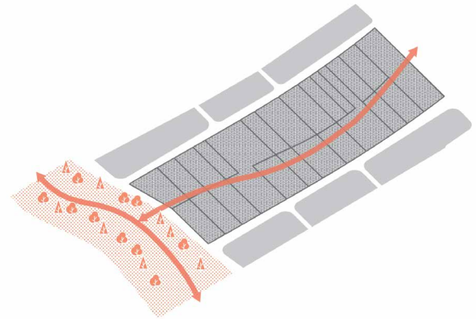
Zoning Bonuses Along Agricultural Ring



Mixed Income and Rental Units



Reduced Backyards for public spaces



East-west connection to trail network

The Local Agricultural Ring

This design scenario uses the agricultural ring as a production landscape to replace agricultural lands taken within land use conversion. The ring is intended to have pathway connections as well as secondary uses, such as offices intended for the business park in the north of the site. Residual heating opportunities from these uses, such as from data centres, can be use to create a district heating network within developments, with the central lines creating heated pathways for walking in the winter months.

Figure 118 Proposed Axonometric Scenario for Inner Ring Expansion

12.6 Conclusions

General

This specific scenario focused on all five of the indicators for sustainability at the core of its design. This is most likely due to the fact that Inner Ring Expansion is currently performing the lowest within nearly all of the indicators analysis. The design is intended to offer a new possibility for designing inner ring areas and integrating the agricultural landscape which often draws residents into suburban areas. Yet, Inner Ring Expansion is often the hardest form of development to change. Provincial, regional, and municipal zoning policies have all attempted to shift the way in which this growth pattern is designed. This has resulted in increased densities within these areas, with the same subdivision patterns. Perhaps focusing on form-based codes and qualitative designs of zoning requirements have the ability to change the practice of Inner Ring Expansion.

Food

Production: Food production was the primary focus of this scenario. Considering that farmers already rent lands from development after purchase has taken place, this partnership does not seem like an unlikely business partnership for more entrepreneurial spirits. Yet the issue still arises of who would take over this model, and how would it become economically viable enough to hinder future development on the lands.

Distribution: The introduction of mixed-use in the area would ideally provide stores which would sell the locally produced food which abutts the buildings. This would create a shorter loop between production and distribution. Of course, food would need to be processed, and could only be grown seasonally.

Consumption: Within inner ring expansion, the goal is to create access to local food consumption as opposed to the current large format box stores surrounding these communities. As previously stated, the access to local food stores and seasonal community gardens provide opportunities for more sustainable consumption.

Mobility

Walkability: This design for Milton's extension creates a greater ease of access for pedestrians and cyclists using a higher density of intersections and increasing access to amenities and services.

Transit Access : Density is focused in close proximity to secondary transit, as well as including sidewalks which could be heated by the district heating network in the winter months.

Energy

Production: The district heating network is the main feature for energy production within this design. As previously stated, heating is the leading producer of CO_2 in residential energy consumption. The introduction of a district heating system for new development could drastically decrease consumption.

Consumption: The heating of units using district heating has reduce the energy consumption. There has also been a new introduction of mixed housing typologies, intended to reduce the energy needed to heat homes significantly. Within this current design, less has been incorporated for reducing electricity consumption within inner ring expansion.

Resiliency and Regional Affordability: This design allows for a more sustainable heating network, which has the ability to be powered by a decentralized renewable energy network.

Ecosystem Services

Water Supply, Quality, and Soil Retention: This design is intended to add significant amounts of conservation lands to the existing ravine system in order to improve the water system and reduce the dangers of flooding with close proximity housing.

Habitat : The addition of the conservation lands will increase forested lands, allowing for more habitat introduction in the urban area. Converting land from agricultural to forested lands significantly increase the likelihood of habitat enrichment.

Recreation : Density is focused in close proximity to the ravine network which contains many trails connecting through the GTA. The new agricultural ring would create a better connection to the existing trail network.

Atmospheric Regulation : Ideally the development would benefit atmospheric regulation due to the focus on plantings and the lack of land use conversion needed for development.

Livability

In addition to the steps made toward livability within the strategies for food, mobility housing and ecosystem services, livability has also been improved through increased walkability, increased access to multi-modal transport, and increased recreational/cultural natural amenities. The strategic increases in density allow for the ability to have a higher percentage requirement for rental housing and mixed income housing units.

What Does This Mean for Regional Planning?

Whereas the highest priority for the Inner Ring is to reduce this growth typology, growth which does occur must achieve greater sustainability. This can be achieved by a focus on new development typologies, strategic focus on secondary transit, an extended setback from ecosystem services. More will be discussed on Inner Ring Expansion and Regional Planning within the recommendations section.

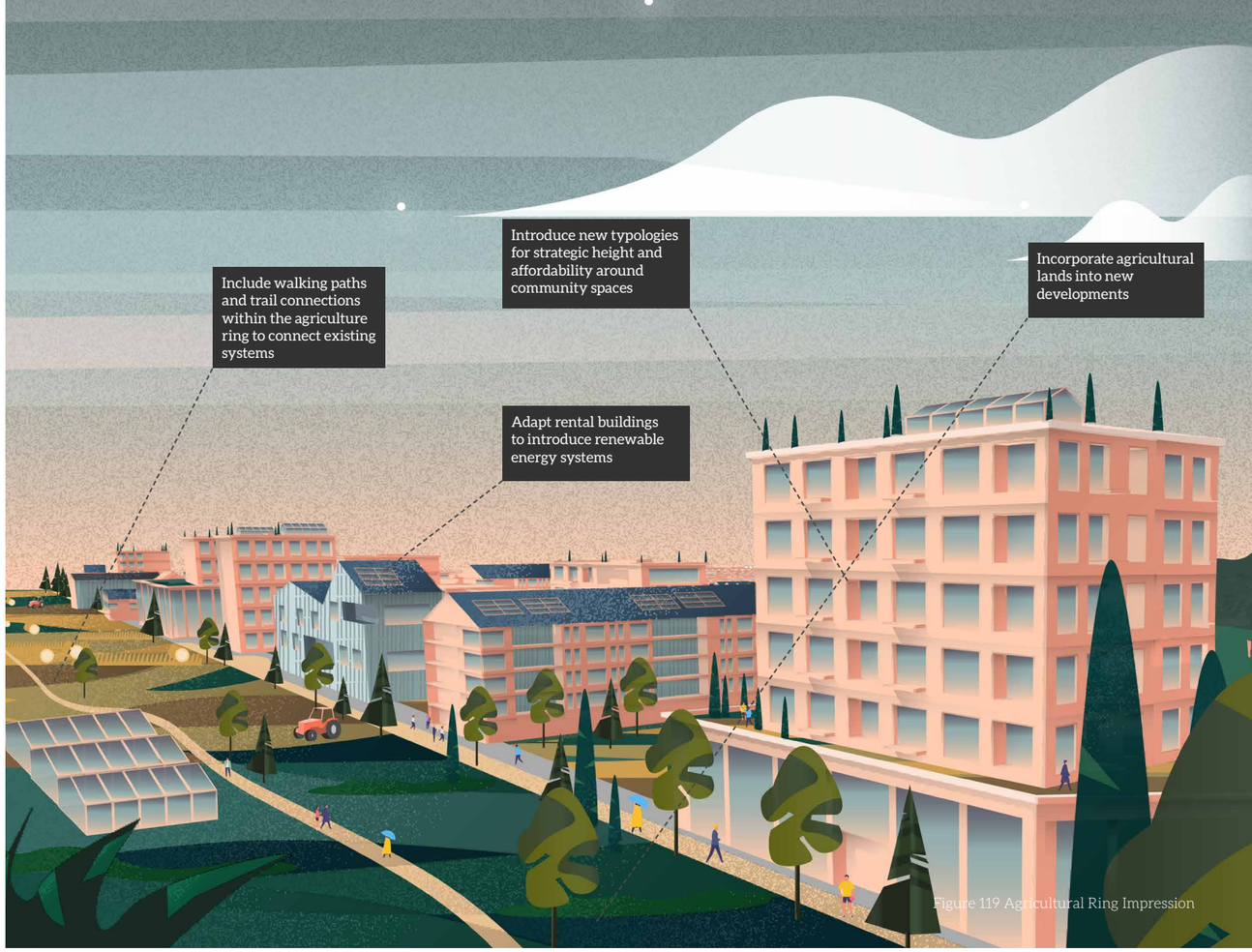
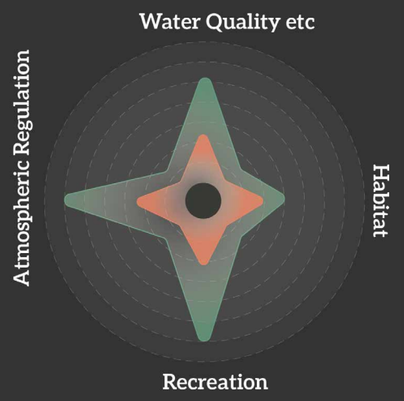


Figure 119 Agricultural Ring Impression

Figure 120 Impression of heated walking network to transit

13.0 Developing Strategies from Opportunities for Outer Ring Expansion

The following opportunities are collected from the analysis of each theme for Outer Ring Expansion. These opportunities are to be integrated into Spatial Strategies below.



Ecosystem Services

Water Quality, Supply & Soil Retention: When considering water quality, supply and retention in future development, it is vital to increase the existing floodplain to take existing and future pressure off of the ravine system. Outer Ring Developments should also limit the amount of hard-scaping in development, including an increased around of road infrastructure per person in developments.

Habitat: By creating more compact developments in the outer ring, non-urban forest will continue to remain 'non-urban' with less visitors and less impact from the adjacent suburban system.

Recreation: By increasing walkability and East-west connections in developments, outer ring expansion could highlight the natural services which surround these neighbourhoods, rather than limiting accessibility to directly adjacent neighbourhoods and by car access.

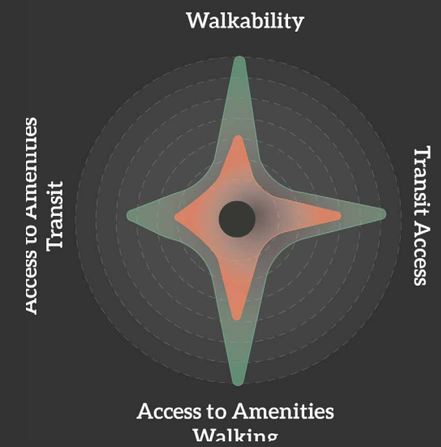
Atmospheric Regulation: Extending the 100 year flood plain will extend the forested lands and wetlands which will improve atmosphere regulation.

Energy

Production: Outer Ring Expansion has a high amount of potential in terms of energy production. The towns themselves are still compact which offers opportunities for energy landscapes in the outer ring of the towns and for new sustainable infrastructure such as district heating.

Consumption: These developments which are already being built at high densities have the ability to include a new mix of housing typologies which will improve heat loss from building monotonous buildings.

Security and Resilience: By creating new infrastructure systems with a more compact design, the distance of infrastructure will likely decrease, as well as add opportunities for decentralized systems which will resist shocks to the larger high voltage network.



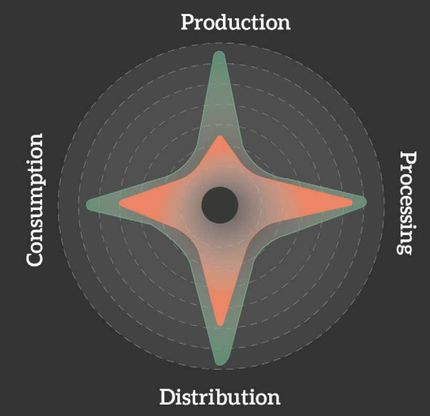
Mobility

Walkability & Automobile Oriented Design: The Polycentric nature of these satellite towns offer the ability to keep the city cores/main streets accessible from all parts of the town. These main centres have historically walkable design and provide street fronting shops and amenities for residents. By developing within close proximity to these streets, growth can take advantage of the existing structure.

Transit Access: These areas have little access to transit unless abutting a primary transit station. The towns with primary transit stations should be the target of the higher amounts of development in the region to gain access to primary stations outside of the urban built boundary.

Access to Amenities by Walking: By integrating new building typologies and strategic density on transit access ways, developments can also target areas for mixed use buildings. These areas can increase the exposure to amenities during walking trips.

Access to Amenities by Transit: Access to transit could increase with increased mixed use types and increased access to primary transit.



Food

Production: Outer Ring Expansion areas are generally surrounded by large swaths of farmland. The growth in the outer ring is slow enough to accommodate within the existing built boundary. This could allow for the preservation of farmland. If the farmers in the adjacent lands wish to sell their land, it is possible that it be sold to energy providers which could use the land for wind power and biogas production while renting back the remaining land to farmers.

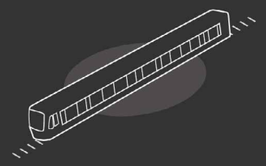
Processing: A large mixture of processing occurs within the industrial areas of these towns themselves. These areas employ a large amount of the population. This creates a short distance from these areas to the city centre. Waste from these processing plants could be used for other additional uses such as biogas or compost.

Distribution: These towns have historically been rural communities with a strong sense of agricultural production and distribution. As one can see the distribution map, these towns have the highest amounts of farmers markets. This should be seen as an opportunity to harness these food hubs and food relations with farm and non-farm populations.

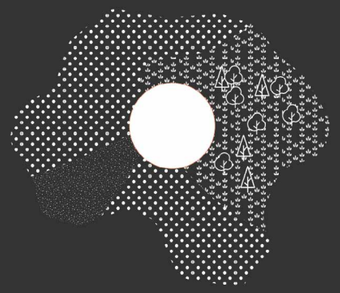
Consumption: Based on the indicators analysis consumption was the highest in these regions due to a higher age population and income. Yet, the suggested consumption of local foods offer an opportunity to harness local production consumption relationships.

13.1 Outer Ring Expansion: Existing Spatial Conditions

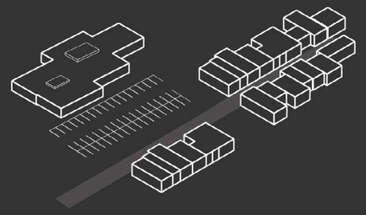
Based on the opportunities analysis of Outer Ring Expansion, strategies must be developed in order to implement changes for the sustainability indicators. The following is a summary of the generic spatial conditions which are found within areas of outer expansion. These spatial conditions are both vital nodes for the community, and also parcels and lots which are opportunities for redevelopment such as monotonous commercial and industrial lands. Additionally, Outer Ring Expansion has the unique condition of a 'separated' community which has its own boundary, centre, and unique context. These conditions should be strongly considered for development.



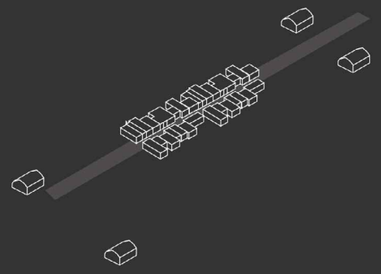
Density on Primary Stops



Density with Access to Walkable Town Centres

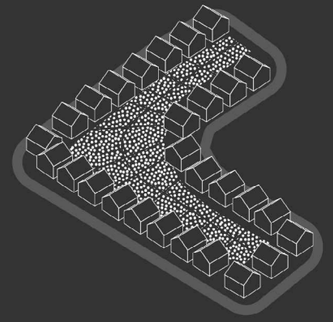


Production systems on abutting rooftops

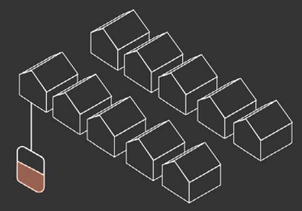


West-East Trail Connections

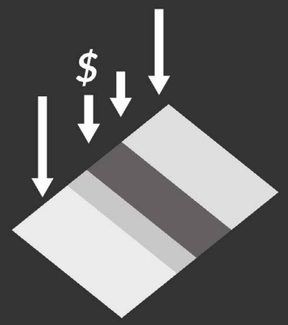
Mono-Commercial Strips to mixed-use streets



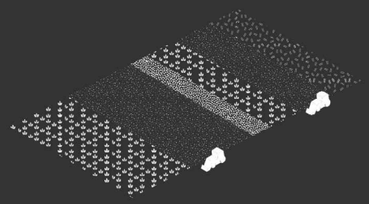
Infrastructural Buffer Lands as Energy and Food Production lands



Rising Land Prices



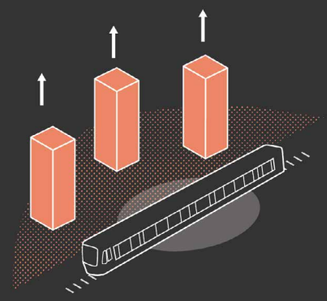
Adjacent Wetlands & Urban Forests



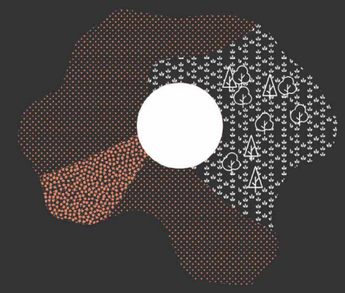
Adjacent Wetlands & Urban Forests

13.2 Outer Ring Expansion: Potential Spatial Strategies

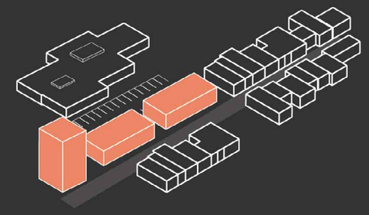
In combining these spatial conditions and opportunities, the following strategies have been developed. The overall goal of the strategy is to develop these rural centres into truly complete self-sufficient communities in regards to mobility, energy, food, recreation, and access to services.



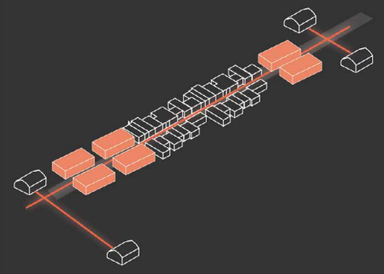
Density on Primary Stops



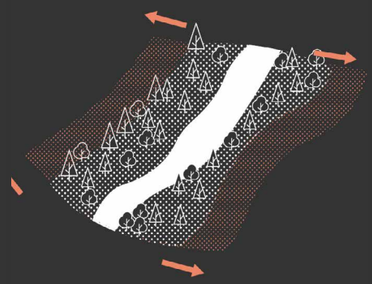
Density with Access to Walkable Town Centres



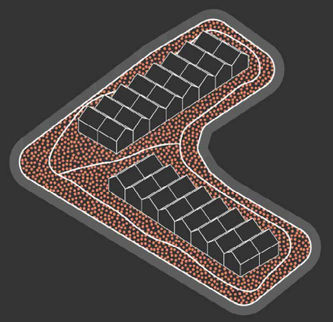
Production systems on abutting rooftops



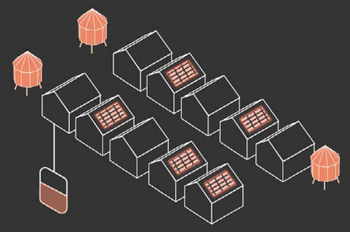
West-East Trail Connections



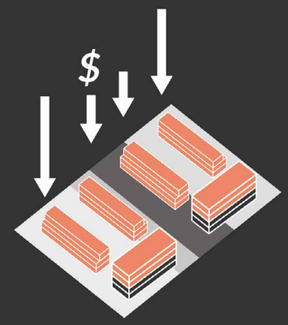
Mono-Commercial Strips to mixed-use streets



Infrastructural Buffer Lands as Energy and Food Production lands



Rising Land Prices



Adjacent Wetlands & Urban Forests

Adjacent Wetlands & Urban Forests

14.0 Generating 'What if' Scenarios

The last 'What if' scenario is intended for the towns included within the 'Outer Ring Expansion' growth classification. This scenario is intended to take advantage of the unique characteristics of these rural communities and use them for sustainable growth patterns.

Outer Ring Expansion

Existing Spatial Conditions

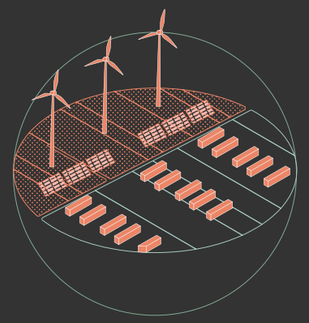
- Primary Transit Stops and Lines
- Existing Historic Town Centres
- Trail Networks
- Local Food Production Lands
- Residual Heat Opportunities
- Food Waste Facilities
- Bodies of Water
- Low Value Land Costs

+

Proposed Strategies

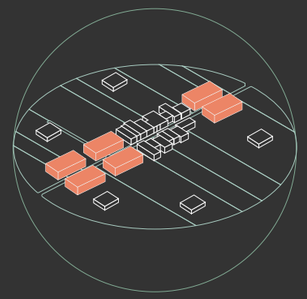
- Density & Transit Stops
- Connect Trails / E.S. to Transit Connections
- Introduce District Heating in New Development
- A Mix of Housing Typologies
- Densify along E.S. networks
- Mixed Use Development
- Integrate Existing Local Food Production Land
- Walkable Routes to Transit
- Decentralized Amenities
- Develop Outside 200 year floodplain

14.1 What if:



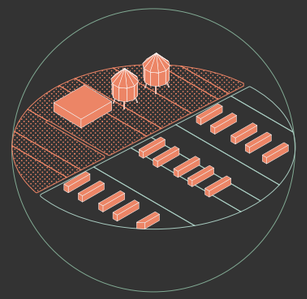
Outer Ring Expansion developed satellite cities, using limiting expansion by creating 'sub-greenbelts' containing **productive landscapes** *to condense development?*

Rural towns in the Outer Ring are expanding quite rapidly considering their previous size. There is still space for growth to be accomodated within the existing built boundary. Is i t possible to create a productive 'sub-greenbelt' around these towns to limit develop and increase the amount of production in the agricultural surrounding lands.



Outer Ring Expansion **re-imagined the rural town "centre line"** *with access from all points of the city?*

These historically rural towns have kept a strong centre known as the 'rural line' these areas contain most of the downtown uses, including the main street and most of the retail located within the town. Considering the towns are still small in size, can they re-envision this central street to accommodate the majority of growth planned?



Outer Ring Expansion accepted the lack of infrastructural preparedness for development, and encouraged **decentralized systems for heating, water treatment, and waste**?

The development of rural communities pose the same issues as classical leapfrog development in North America. This is due to a lack of infrastructural preparedness for development. Can these areas integrate decentralized systems for heating, water treatment and waste when infrastructure must finally be built?

14.2 Locating Spatial Parameters

Ideal Built Boundary Areas, Hamlets to be Avoided, Primary Transit, and Existing Water Treatment Facilities

The spatial parameters needed for this What if Scenario includes parameters which are necessary for these smaller municipalities to support growth, based on the issues identified with the growth of these towns through research. Firstly, based on the current Growth Plan, it is vital to identify communities which have a built boundaries. This makes these areas subject to the growth conditions similar to Inner Ring Expansion. The villages (triangles) which do not have a boundary should be avoided, as the Growth Plan provides less regulation for these communities, whereas the entire settlement boundary is more open for development. Additionally, train or GO bus networks are vital for future growth in these communities. In order to encourage public transit, these regional networks are the spine of sustainable mobility. Lastly, many communities are struggling with adapting water treatment services to adapt to new growth. Towns which have existing water treatment and sewer systems are more ideal for future development.

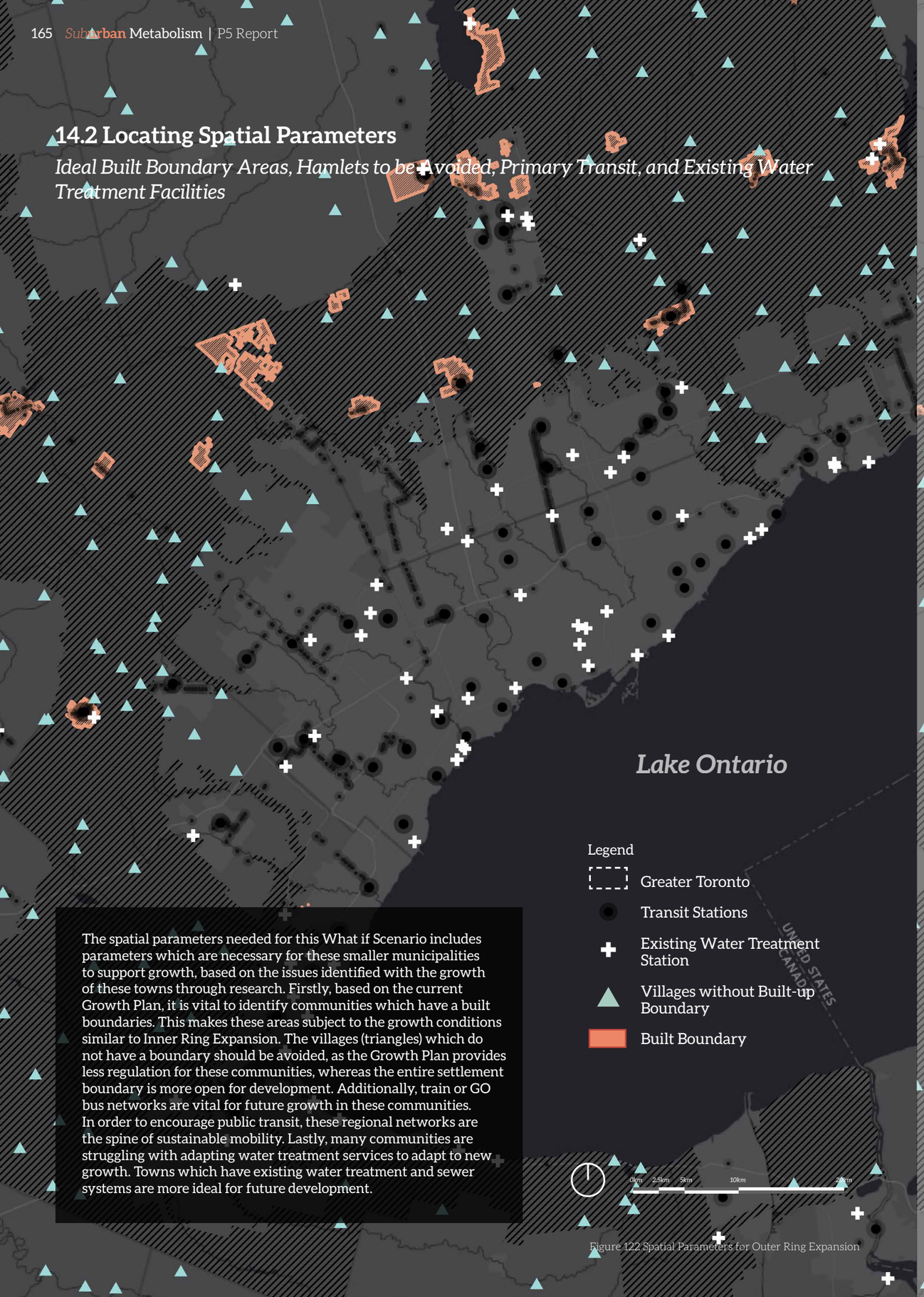


Figure 122 Spatial Parameters for Outer Ring Expansion

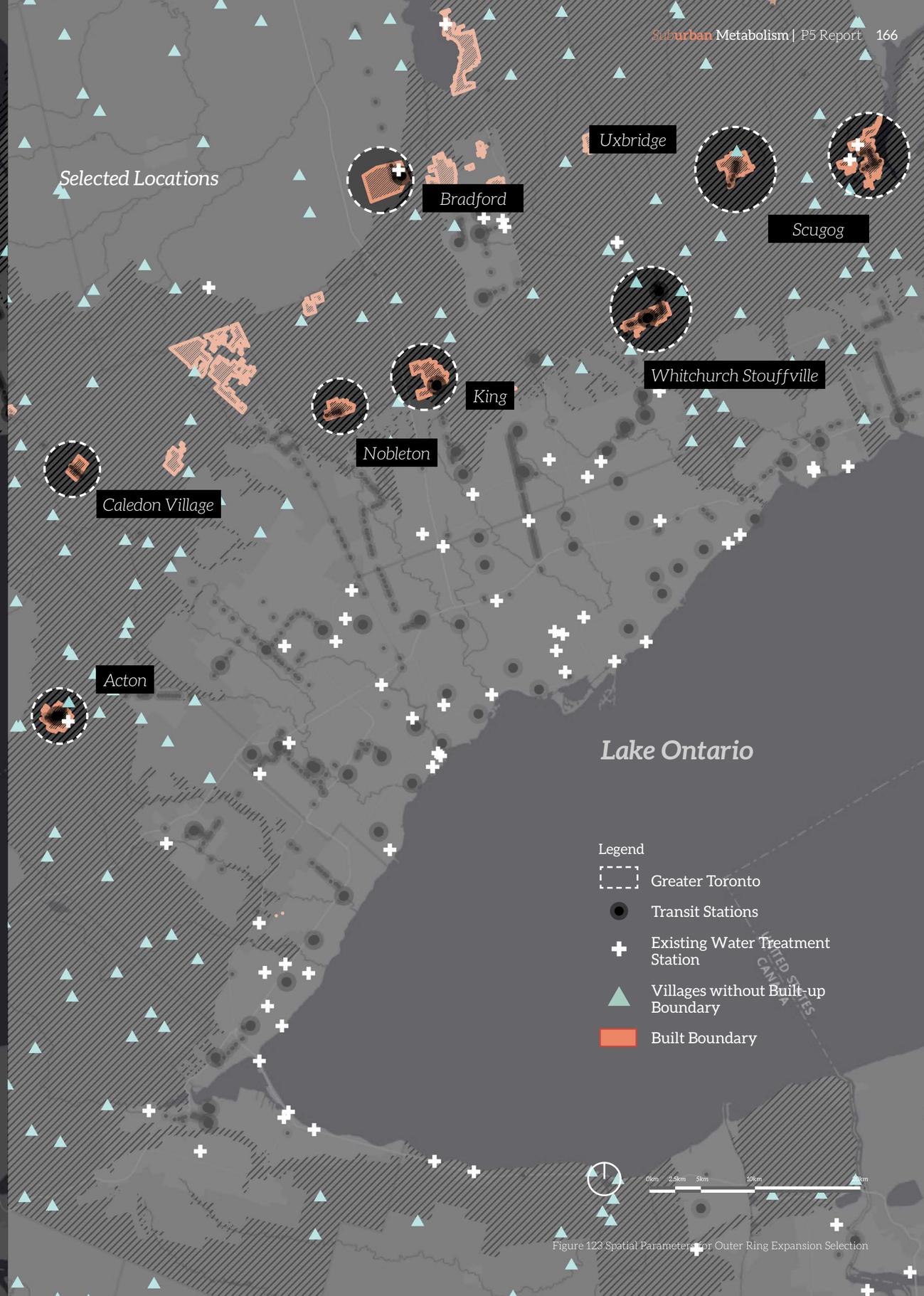


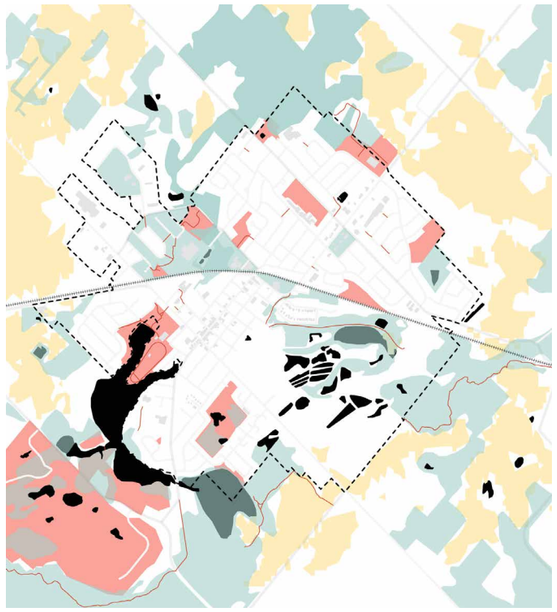
Figure 123 Spatial Parameters for Outer Ring Expansion Selection

14.3 Selected Locations

The Outer Ring Townships

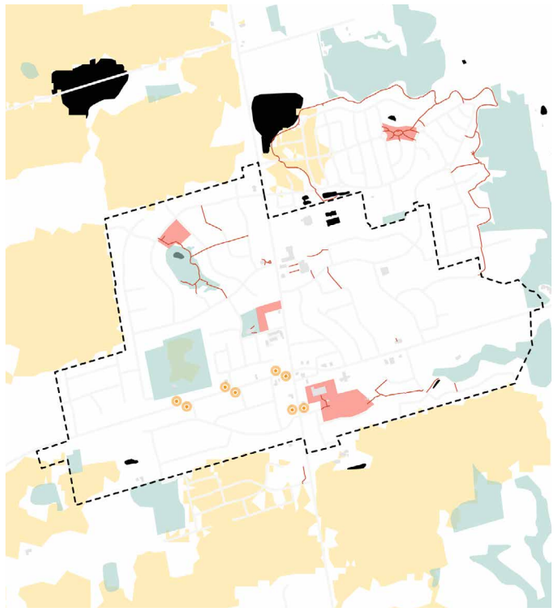
Legend
- Greater Toronto
- Transit Stations
- Water
- Industrial Lands and Mono-functional Commercial
- Park Lands
- Crop Lands

Acton

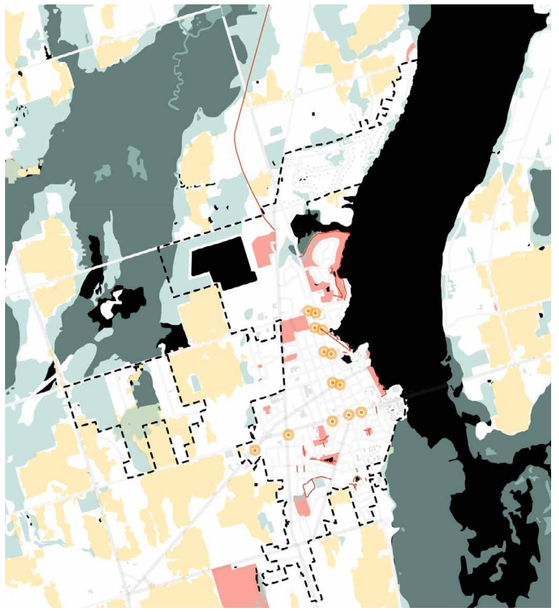


Bradford

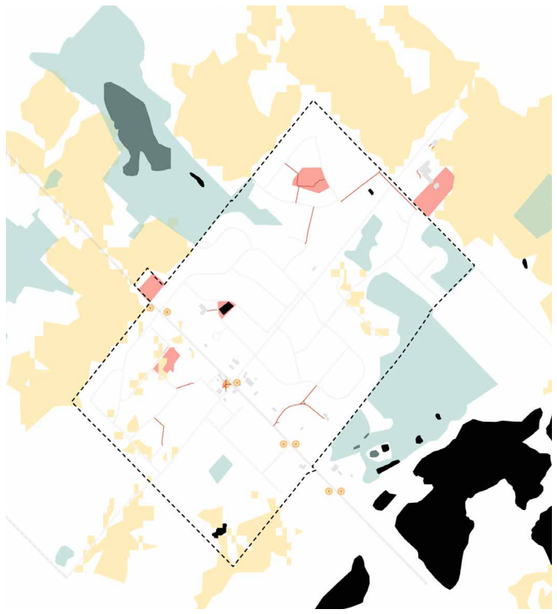
Nobleton



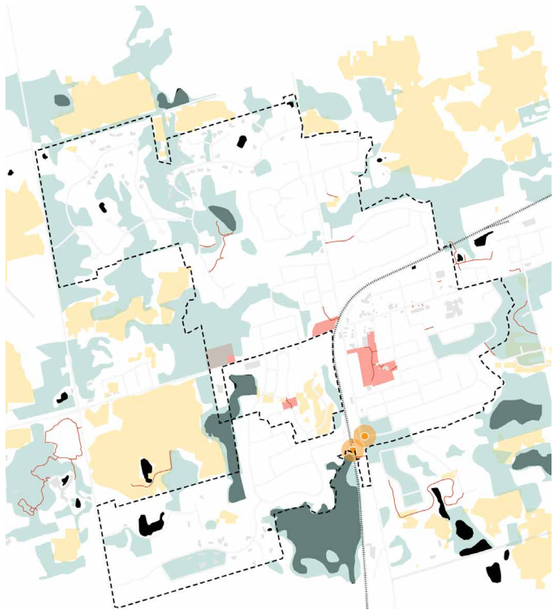
Scugog



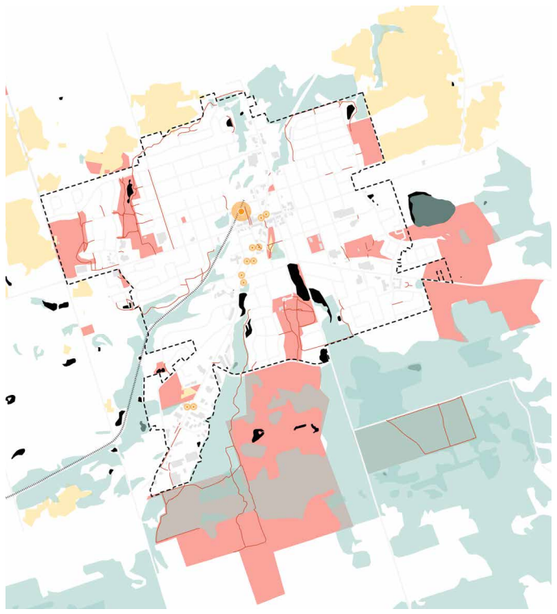
Caledon VIllage



King City



Uxbridge



Stouffville

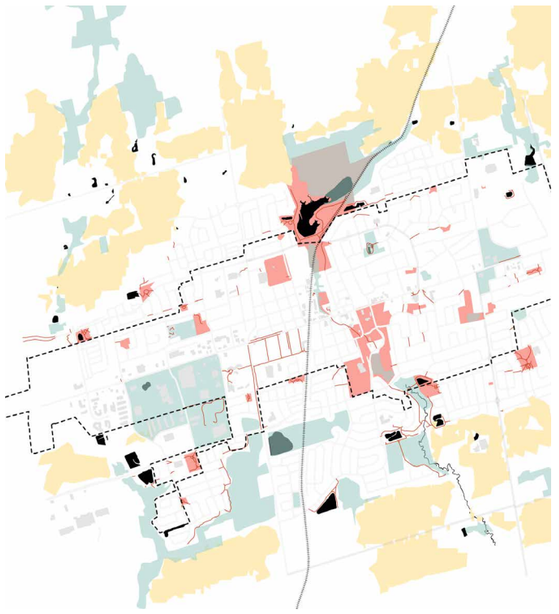
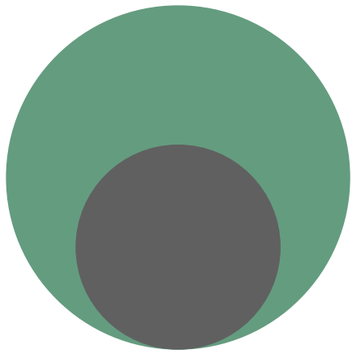


Figure 124 Selected Municipalities Zoom ins Source: GIS Scholars Geoportal and OSM

Summary of Growth Patterns and Projections

Smaller communities in the Outer Ring are preparing for growth by budgeting land for expansion. This includes estimating the area of greenfield lands which are needed for growth in the region. According to the Neptis Foundation, the amount of greenfield areas is significantly higher than necessary. If the urban expansion lands are estimated at 4,400 hectares, this means that this accounts for 250% of the lands needed for the projected growth targets of these municipalities. This is more concerning when considering that the areas are often located within or abutting the greenbelt. How will this expansion affect the condition of our region's ecosystem? It is critical to understand the lands actually needed for these areas, and to provide the necessity, not an over-abundance. The possibilities foe a new growth vision for these communities will be explored in the next section.

4,400 hectares
of established urban expansion lands



250% of the land needed for the projected growth target for Outer Ring municipalities

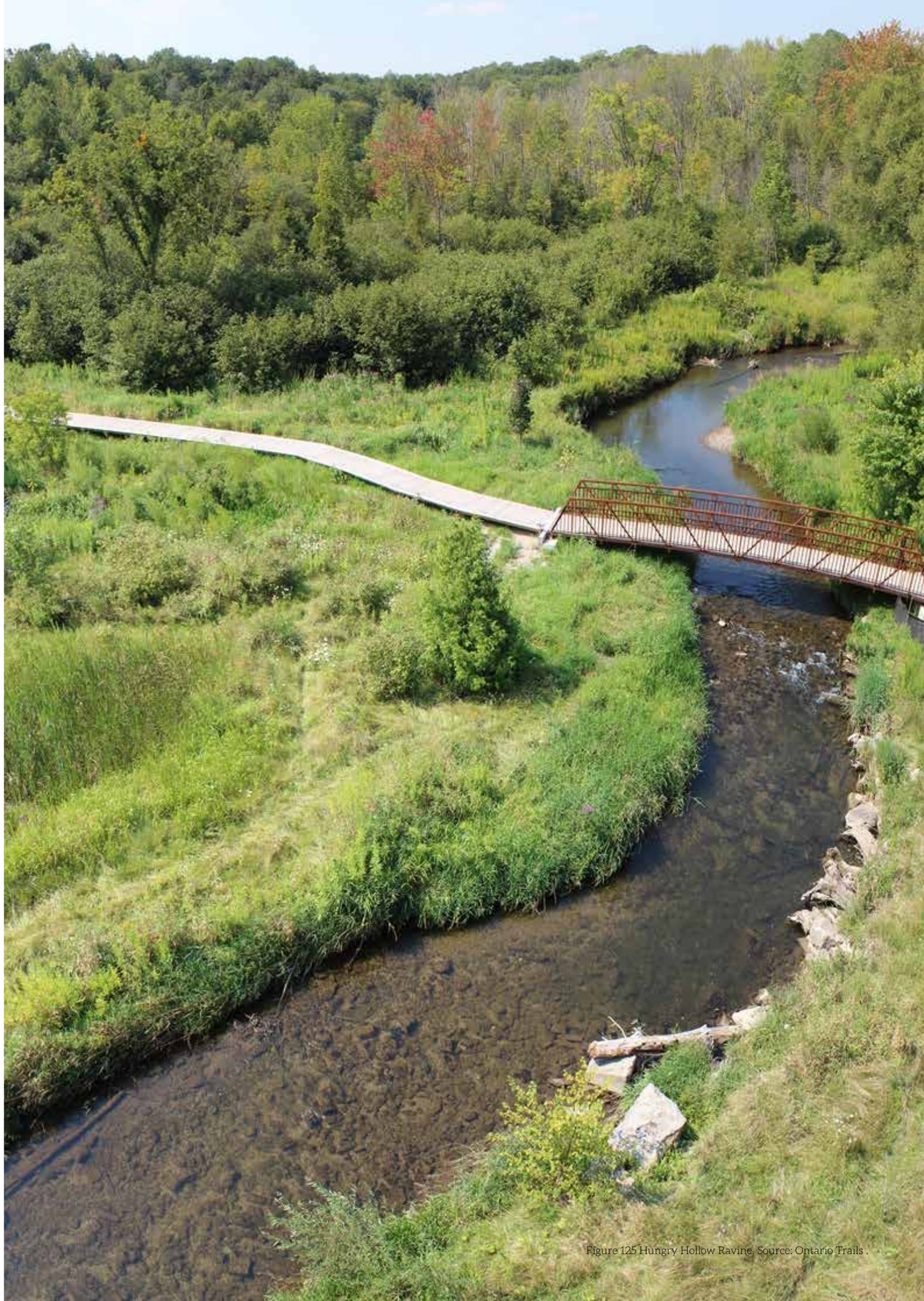


Figure 125 Hungry Hollow Ravine, Source: Ontario Trails .

14.4 Bradford Ontario

The Historic Rural Town

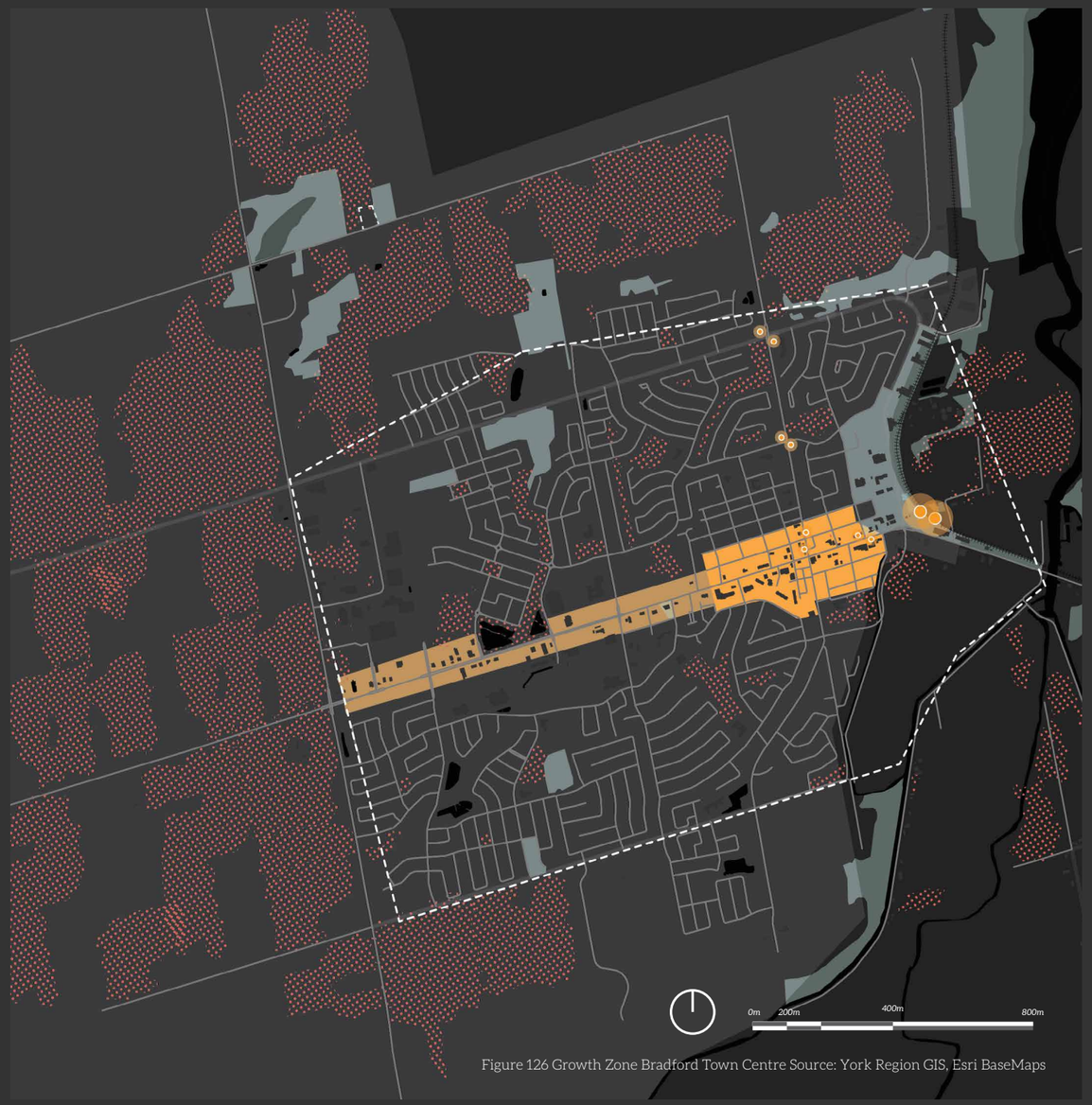


Figure 126 Growth Zone Bradford Town Centre Source: York Region GIS, Esri BaseMaps

These historically rural towns have kept a strong centre known as the 'rural line' these areas contain most of the downtown uses, including the main street and most of the retail located within the town. Considering the towns are still small in size,much of the built area can still walk to the city centre. The city centre of these communities also have a large amount of buildable space, including the large box stores which litter past its main streets.

Legend

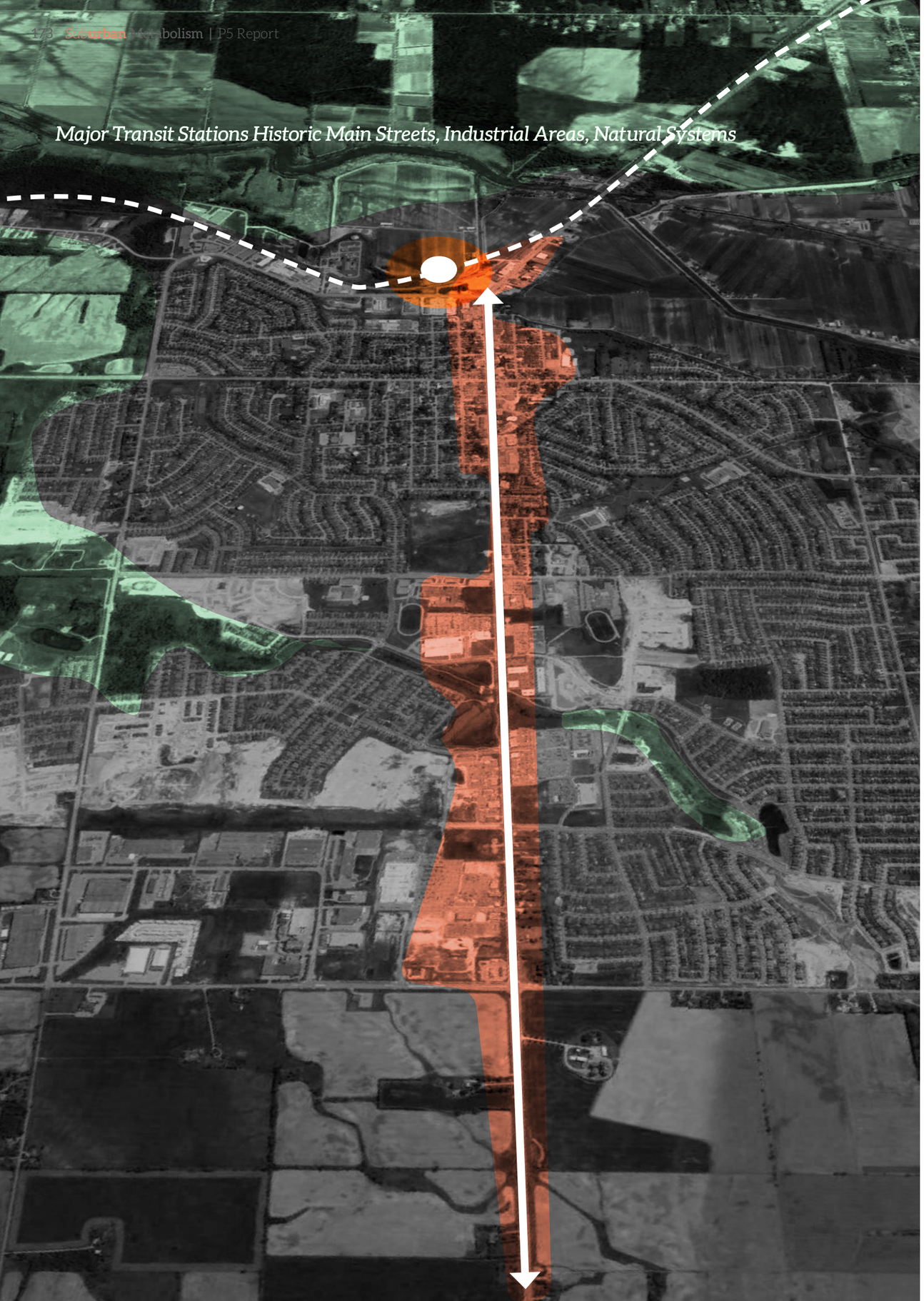
- Built Boundary
- Transit Stations
- Growth Potential/Centre
- Crop Land
- Parks
- Water

Bradford Project Location/Area of Interest

Figure 127 Growth Zone Bradford Town Centre Source: York Region GIS, Esri BaseMaps

Legend

- Built Boundary
- Transit Stations
- Growth Potential/Centre
- Crop Land
- Parks
- Water



14.5 Bradford Ontario

Figure 128 Main Street Bradford Source: Flickr

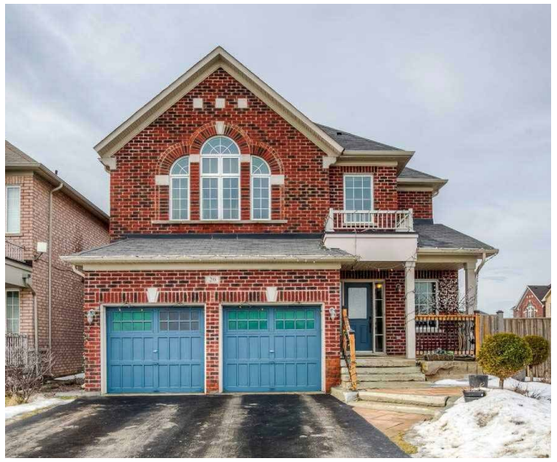


Figure 131 Home in Bradford Soure: Reak Estate Canada

Figure 129 Holland Marsh Agricultural Land Source City of Bradford

Figure 132 Walmart Brandford Source Google Street

Figure 130 Agricultural Area Bradford

Figure 133 Highway 400 Series Bradford

Bradford's Existing Connections and Land Use

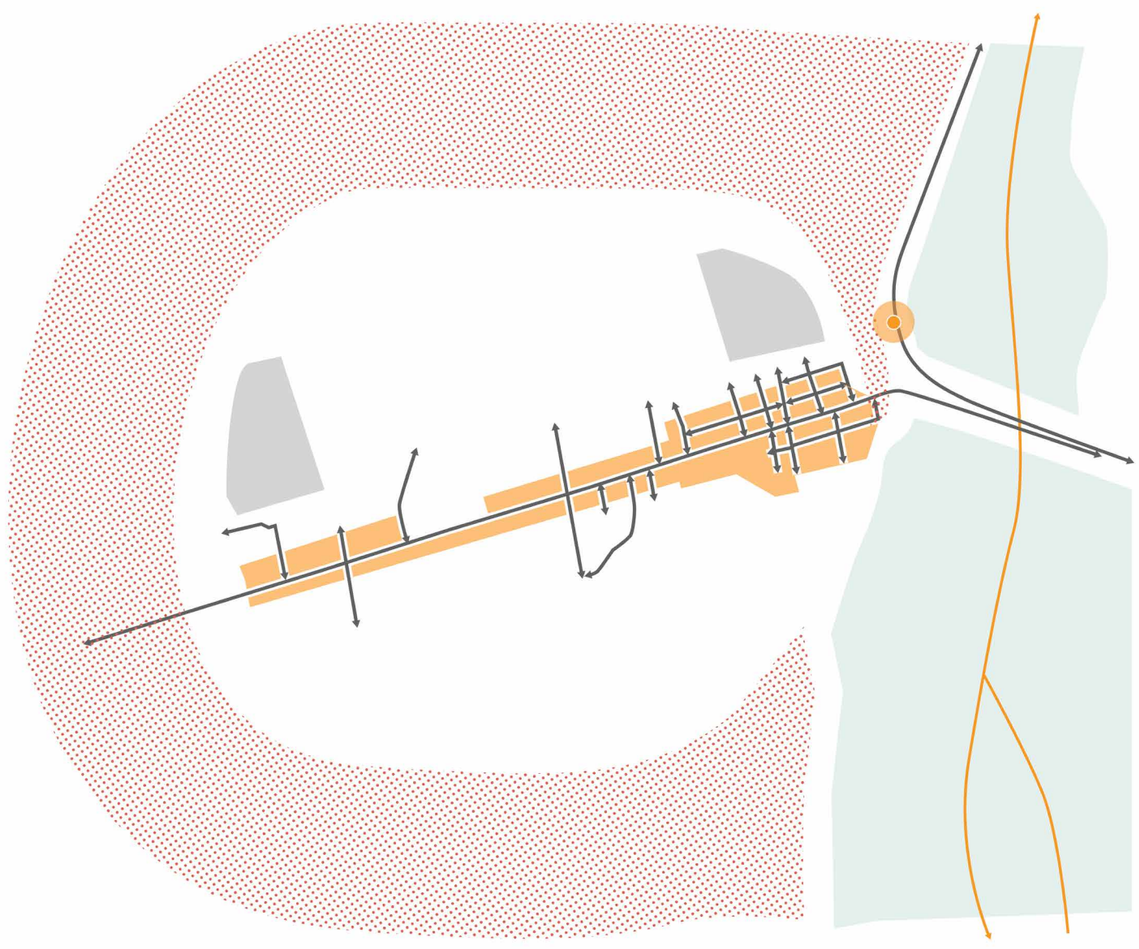


Figure 134 Bradford's Existing Connections and Land Use

The following diagram shows the existing road connections, trail network, train lines and core main street in the district. The intent of the design will be to connect both side of the rail network to the main street core, as well as the natural trail network to the west.

Proposed Connections and Land Use

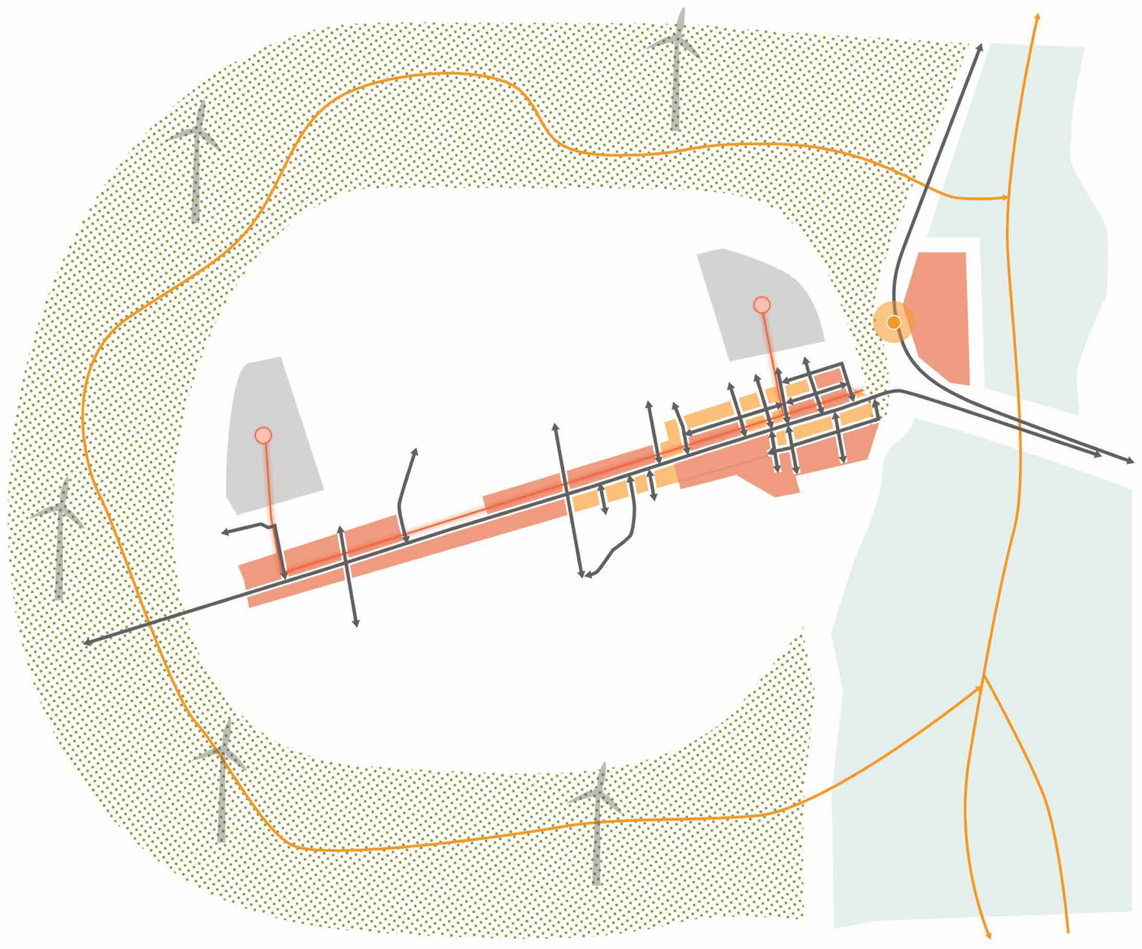
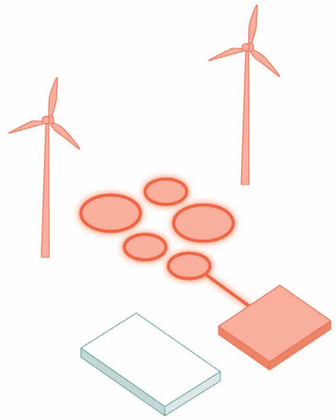


Figure 135 Proposed Connections and Land Use

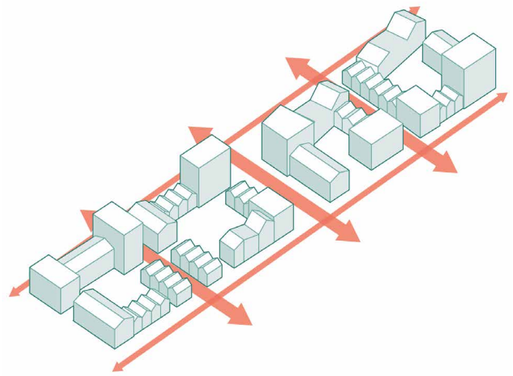
This concept diagram reveals the intent of the 'sub-greenbelt' in order to reduce the amount of urban expansion, create a production landscape as well as provide connections to the existing trail networks. The design also proposes to make use of the many food processing site within the Bradford Industrial Areas and harness their waste and surrounding agricultural waste to create a biogas plant for district heating. District heating network would be ideal in this scenario due to the compact, linear development which would take place creating less infrastructure requirements for the new energy project.

Major Transit Stations Historic Main Streets, Industrial Areas, Natural Systems

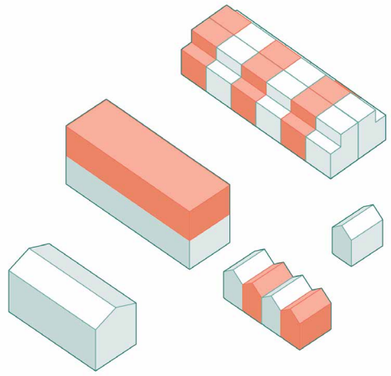
Most of the project growth can be accomodated within these growth areas. By replacing targeted mono-functional commercial spaces and introducing a mix of housing units, the scenario provides a linear development which would enforce the core of rural communities.



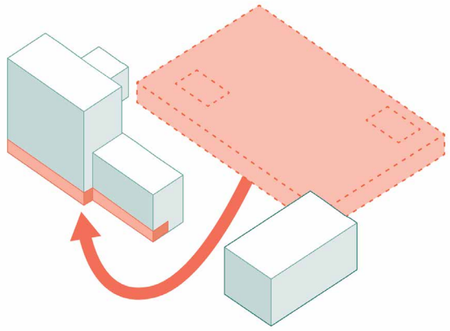
Integrating existing industrial and food processing waste into biogas heating system



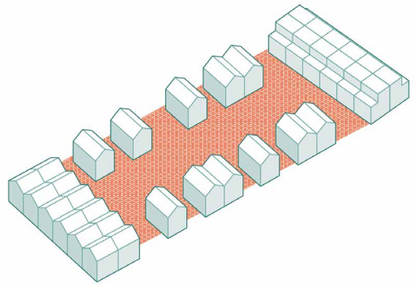
Walkable Grid Connections



Mixed Income and Rental Units



East-west connection to trail network



Reduced Backyards for public spaces

The Rural Line

This design scenario transforms surrounding lands into productive landscapes which inhibit future development, continue to produce food, introduces new energy infrastructure and also provides a recreational trail network. The central line creates spaces for community uses, interior farmers markets and a mix of new, but sensitive housing developments.

Figure 136 Proposed Scenario for Outer Ring Expansion

14.6 Conclusions

General

This scenario is intended to focus on the unique qualities of rural communities in Outer Ring Expansion areas. These areas have the strong potential of developing in a way which is unique in comparison to the development within the inner ring, but current practices do not reflect this. The densification of the rural line does not need to be extremely dense in order to accommodate most of the growth which will happen in Bradford for the next 20 years. This growth can also replace the large monofunction box stores which populate this main street and which are known for destroying the local retail of rural town centres. Given the lessened growth and aging/ non-existent infrastructure, there is also an opportunity to challenge new development to improve infrastructure beyond the status quo.

Food

Production: Food production a focus within the sub-greenbelt. The energy landscapes which are proposed in this scenario also add an ownership relationship between the energy providers and the farmers who may still rent and farm the land surrounding the community.

Processing: The Outer Ring Expansion is the only scenario which was able to harness the potential of food processing in the area. The proposal suggests that waste from the many food processing plants be used to fuel biogas powered district heating plants.

Distribution: As shown in the analysis, the distribution of local foods in these communities in farmers markets creates a close relationship between production and distribution. Limiting the amount of large box stores and increasing incentives for the BIA is crucial in continuing this relationship of food distribution.

Consumption: Within outer ring expansion, the goal is to create continue the high access to local farmers markets and local stores in the community.

Mobility

Walkability: This design for Bradford ensures that all new development is within the walkable areas of the downtown core and that the current linear street maintains access to local shops, and the primary transit station located east of the main street.

Transit Access : If density is focused in the rural line, communities will have the ability to walk to transit from any new development.

Energy

Production: The district heating network is the main feature for energy production within this design. As previously stated, heating is the leading producer of CO2 in residential energy consumption. The introduction of a district heating system for new development could drastically decrease consumption. There is also the introduction of wind energy within the agricultural lands, but this also provides conflicts as rural communities have been practicing protests against these wind turbines.

Consumption: The heating of units using district heating has reduce the energy consumption. There has also been a new introduction of mixed housing typologies, intended to reduce the energy needed to heat homes significantly.

Resiliency and Regional Affordability: The outer ring is also the growth typology which has the highest incentives for introducing renewable electricity. The rising unaffordability of HydroOne electricity in rural areas has created unrest among these communities. These services also have common black out periods, even in the winter months. Have a back up renewable electricity and biogas heating system allows for new residents to have a resilient and affordable system, but also allows current residents to have emergency access spaces if there are outages.

Ecosystem Services

Water Supply, Quality, and Soil Retention: This design is intended to add significant amounts of conservation lands to the existing ravine system in order to improve te water system and reduce the dangers of flooding with close proximmity housing.

Habitat : The addition of the conservation lands will increase forested lands, allowing for more habitat introduction in the urban area. Converting land from agricultural to forested lands significantly increase the likelihood of habitat enrichment.

Recreation : Density is focused in close proximity to the ravine network which contains many trails connecting through the GTA. The new agricultural ring would create a better connection to the existing trail network.

Atmospheric Regulation : Ideally the development would benefit atmospheric regulation due to the focus on plantings and the lack of land use conversion needed for development.

Livability

Many residents are moving toward the outer ring in search for affordability and open spaces. The vary growth of these areas ironically limit this. By densifying the rural line and conserving the outer ring, residents will continue to have public access to these areas in the future. In addition to the steps made toward livability within the strategies for food, mobility housing and ecosystem services, livability has also been improved through increased walkability, increased access.

Of course, the costs of these changes will not be low. Yet, similar to IRE, if areas are improving infrastructure, more should be done to create more efficient energy systems. In order for municipalities to afford such projects, more must be done to adjust the market regulations of development charges which reflect 'true cost'. This will be discussed later in the recommendations section

What Does This Mean for a Regional Plan?

Based on the analysis, strategies, and test scenario, it is evident that growth in Inner Ring Expansion areas have more potential than what may be assumed. While many issues are stemming from growth and expansion in these regions, many have the ability to hand growth in their existing built boundary. If these communities could develop on their central lines, then perhaps they could become partially self-sufficient satellite communities. These areas which are rich with community participation, landscape, and historical town centres have the ability to harness their opportunities. A regional plan has the ability to target or instigate growth in selected communities based on the spatial parameters necessary for growth. With incentives such as zoning bonuses, land budgeting tactics, and more regulations for expansion lands, a regional plan can instigate change. More on this will be discussed in the recommendations section.

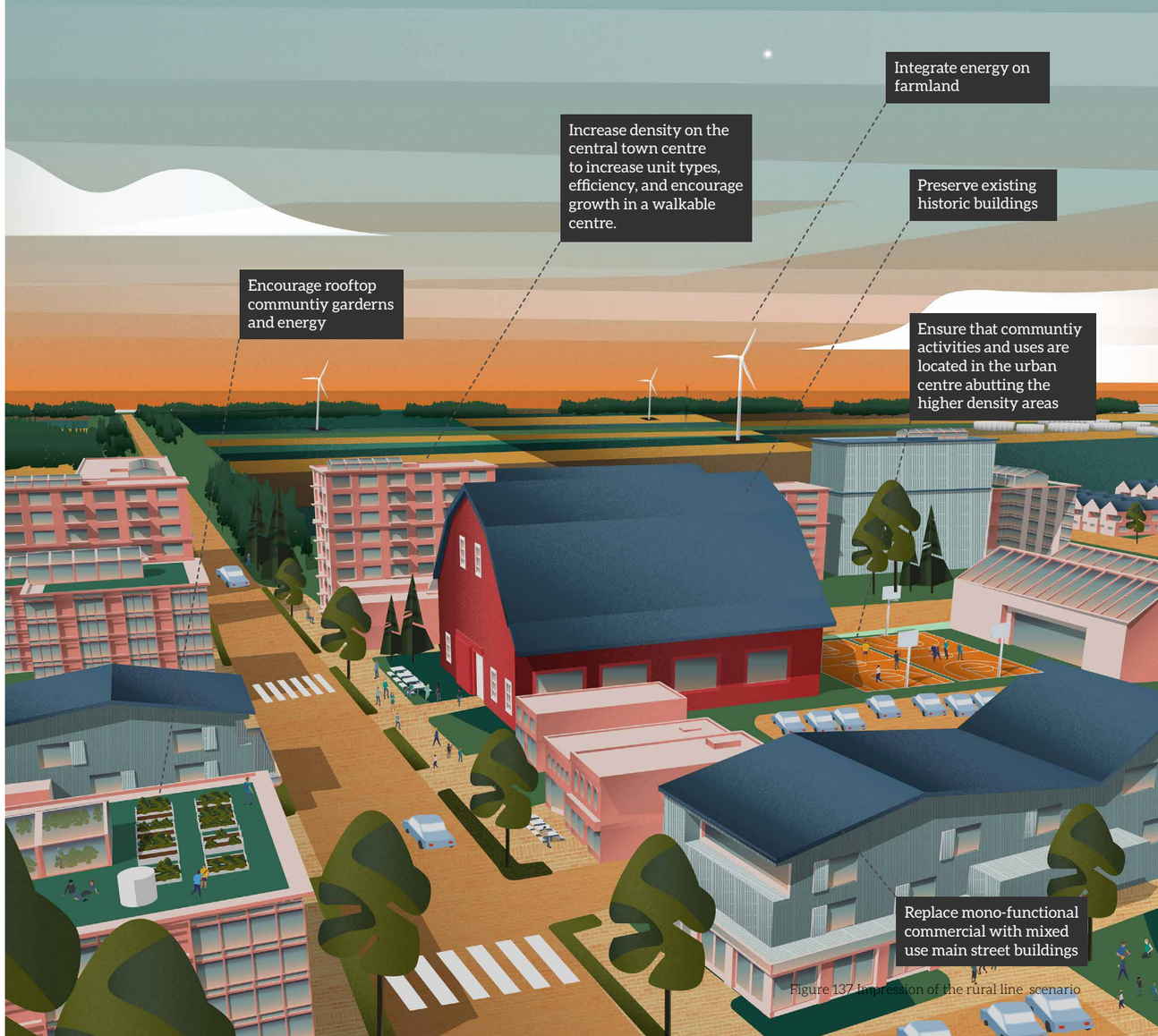


Figure 137 Impression of the rural line scenario

15.0 Recommendations & Policy Implications

15.1 Urban Intensification Recommendations & Policy Implications

Urban Intensification Conclusions: (More) Sustainable, Less Attractive

Existing Urban Intensification outside of the municipal Toronto boundary has had mixed results in terms of what is 'sustainable'. The analysis has shown that these areas do indeed have higher access to transit, moderate access to local food stores, have less impactful land use conversion, higher energy performance, and even increased access to parks and green space. It is important to note that within this analysis, these areas are being compared to largely monotonous subdivision design and therefore it is a reach to label them as 'sustainable' development based on this alone. Though Urban intensification has a higher performance, it has often failed to create the walkable and complete urban centres as is suggested in official policy language promoting this form of development. Yet, this kind of 'neutral sustainability' becomes less effective when considering the lack of growth that it provides in the region. If only a small fraction of growth has resulted from intensification, the benefits from this form of development are currently negligible. Arguably, to make a more significant change, urban intensification developments should become a reference point to sustainable and/or complete communities so that a moderate impact may turn into a significant change given their current growth percentage. Yet, further restrictions on Urban Intensification may hinder development even further. This points to two broader problems and two broader choices for future growth. On one hand, there is a lack of intensification which must be increased, on the other hand, it has failed to create meaningfully sustainable development beyond its location in an urban area which may be improved through policy and design changes.

The Lack of Intensification

Issues of Affordability and Livability

To address the lack of urban intensification, we have to look at a multitude of factors. The most prominent that have surfaced within research has been the issue of land prices and customer choices. Land prices themselves are a tricky concept, but there remains a slew of opportunities for incentives for urban intensification which should be implicated at the regional, provincial, and federal scale. Consumer choice, though a market-driven concept, is deeply rooted in livability. Consumer choice, which drives urban intensification, is influenced by affordability, transportation, proximity to high-quality neighbourhoods, and design and amenities (Region of Peel, 2010). Out of these indicators, affordability generally has the highest amount of influence on the development and choices of living in the GTA (Region of Peel, 2010). While this has historically driven consumers outwards, it can also drive them inwards to urban intensification units as outer prices rise. The average price of a resale condominium is lower than the average cost of a single-family home in the GTA (Region of Peel, 2010). Yet, the actual units themselves have been catered towards a specific amount of the population including single persons, empty nesters, and elderly persons. This has created the ever-shrinking unit sizes. In May 2007, the average condominium was 82 square metres, while now it has shrunk to 70 square feet in May 2015 (Marr, 2017).

> *"But unlike in the detached home market in the largest cities, where it has long been the practice to keep driving until you can afford something, condo developers seem to have adopted a philosophy of shrinking units until they can meet consumer budgets and bite-sized investor appetite." (Marr, p. 2, 2017)*

Of course, the shrinking unit sizes are part of an issue of providing affordability. In order to increase the movement towards Urban Intensification, the region must provide a system which allows for affordable urban development in the built boundary.

The Missing Middle

This brings us to the existing discussion on the "Missing Middle" in the GTA. This concept was a general response to the "tall and sprawl" phenomenon that has defined the region's growth. Most construction has either provided one bedroom condos at a high-density or subdivision housing on the ever-spreading fringe. According to Ryerson's Missing Middle study, the majority of condo units under construction in the Toronto region are one-bedrooms in tall buildings over 20 storeys (Haines & Aird, 2018). Homes for families and for alternate buyers are not being built in centres, creating a choice between a small unit or a lengthy commute. Many families will choose a considerable commute. This eludes to the subject of the Missing Middle. The Missing Middle discussion not only speaks about mid-density, mid-rise, but also mid-unit sizes and rent-geared-income units (Haines & Aird, 2018). The current conversation around the missing middle claims that urban intensification will become more attractive to more families if we provide a mix of unit types and open lands for intensification.

How can Planning Increase Intensification which is Affordable and Livable?

Undoubtedly, the lack of intensification in the GTA is a complex issue, but there are methods in which planning can employ to increase the number of intensification units in the region.

Reducing Restrictions and Creating More Opportunity for the Missing Middle

One key element is reducing the restrictions that municipalities employ for planning intensification. Instead of creating an abundance of intensification opportunities through zoning and Official Plans, municipalities generally prefer a reactionary solution to identify development areas (Haines & Aird, 2018a). It is possible for municipalities to remove barriers and fast-track mid-rise housing applications within existing urban cores (Haines & Aird, 2018a). It is up to planning to create new assumptions about allowing urban housing if it is intended to flourish.

Creating more transparent Agreements

It is common within some GTA municipalities to practice 'under the table' negotiations with developers which can include decisions on what community benefits will be included, or not included and replaced with cash in lieu payments (Gordon, 2016). This pertains mostly to Section 37 in the Ontario Planning Act. In Section 37, the Act provides an incentive-based system that allows municipalities to authorize increases in the height and density of development than which is currently allowed in the existing zoning by-law (Ministry of Municipal Affairs and Housing, 2011). The use for this section must align with goals in the municipality's Official Plan documents. It is quite common in urban development to enact Section 37, as rezoning for height is generally practiced (Ministry of Municipal Affairs and Housing, 2011). Yet, in many municipalities, these negotiations for community benefits are happening behind closed doors and are not publicly available, even in Municipal Toronto (Ministry of Municipal Affairs and Housing, 2011). It is common to leave Section 37 agreements until the end of the development approval process. As an example of a combative response, the City of Vaughan has committed to new, and more transparent negotiations surrounding community benefits where negotiations begin at the beginning of the process (Gordon, 2016). It is crucial for a transparent process to occur within municipalities in order to consult communities on what and why community benefits are being included and use this as a tool to create better and more attractive communities and also incorporating sustainable community developments.

Lowering the Risk for Development and Accommodating the Mid-Density

One key element is reducing the restrictions that municipalities employ for planning intensification. According to Ryerson University, most planning documents have outdated assumptions about land budgeting and land within urban built up areas are not seriously considered for development (Haines & Aird, 2018b). In Ontario specifically, surveys have found that almost 75% of mid-rise buildings have required rezoning before development (Haines & Aird, 2018b). A Regional plan should help develop a framework to review intensification opportunities to assist these regions in pre-zoning areas and instigating development, rather than reacting to it. Municipalities gain more from these developments, as they lack the need for expansive servicing and infrastructure.

Purpose-Built Rentals

As the security of condominium sales is on the decline, purpose-built rentals are on the rise (Urbanation, 2017). Purpose-Built rentals are a more direct way of providing affordable housing within the GTA, rather than depending on individually owned condos being converted into rentals (Urbanation, 2017). This is caused by surging housing prices and the large portion of incoming young population migrating to urban areas. According to Urbanation, rental levels rose nearly 15% in the last five years (Urbanation, 2017). Encouraging this movement through a mix of housing developments and an increasing land area incentivised for development.

Creating Attractive Livable Communities

While affordability and accommodating the Missing Middle is vital in creating and attracting new growth, Urban Intensification must also challenge what is driving more diverse populations outside of the city. This includes family-oriented open spaces, natural areas, and necessary amenities, which are general ideals of 'suburban livability'. The 'tall and sprawl' movement has created a decision to choose a large apartment tower in the centre of a parking lot, abutting a strip mall, or subdivision-style development with a longer commute. To many, the tower is an unrealistic choice. It is becoming clear that urban intensification in the region has not steered far from 70s modernist apartment blocks which border the inner city currently. A difference remains that the modernist blocks (though flawed) contain larger amounts of green space and recreational facilities than its contemporary counterparts. This is not a call for neo-modernist ideals, but it shows us that as a region, we have managed to develop a similar housing style which is still based on a separation of land uses, separation of transportation modes, and separation of different demographics. So, how do we create attractive communities through urban intensification without separation? In addition to providing affordability, the remaining task is to provide access. Residents need access to amenities such as parks, natural areas, schools, health care etc. This access should be within an existing walkable centre, not within mono-functional commercial development. As previously stated within the analysis, many urban intensification areas do have access to parks and natural areas within walking distance, but more must be done to include green spaces into actual development lands. Strategies for this can include half grade parking with parkland above or even municipalities anticipating density around the existing ravine network. More than just attracting residents, creating

attractive communities should be tightly paired with changes toward sustainable development in urban intensification. More must be done to integrate Regional green networks into the GTA to instigate changes in the Official Plans of municipalities.

> *"With the emergence of residential high-rises along the Sheppard corridor, ridership on the Sheppard subway remains low, not entirely because of low densities, as it is often blamed, but more-so because of the built form which remains stubbornly car-oriented. Tall residential towers are surrounded by gas stations and empty fields, parking lots and big box stores, with no connection to the subway and no public realm to speak of. When the transit accessible option is a tower in a barren field on a busy suburban artery, I don't disagree." (Haines & Aird, 2018c).*

Sustainable Development and Urban Intensification

Throughout the analysis, it has become clear that Urban Intensification had a higher performance in terms of sustainability within the existing development context. Most of these qualities are obtained from building within an urban area through more compact developments. This reduces the negative land use conversion associated with greenfield development, lessens the amount of infrastructure necessary for new builds, and, by default, provides higher access to existing transit for more residents in comparison to other forms of development. Yet, given the small portion of growth which is actually accommodated through Urban Intensification, the true impact is less than what it could/should be. Of course, an increasing amount of these developments are ideal, but if the trend (or even an improved version of the trend) continues, then we must make Urban Intensification have more impact based on these issues. The biggest challenge remains that urban development already creates a more complex situation for developers, planners, and the surrounding community. Incorporating even more regulations for development could strain the ability to provide affordable housing in the first place. Methods must be put in place to heavily incentivise sustainable strategies that can have the highest impact given the current context. This includes numerous policies on the federal, provincial, regional, and municipal level, but also design strategies which can guide municipalities through design and implementation which will be discussed later in the recommendations section.

How can Planning Policies Increase Sustainable Development in Intensification?

Using Section 37 for Sustainability Initiatives

Section 37 is meant to be used for 'appropriate community benefits'. This can include a large range of benefits from affordable housing to public parkland and natural heritage systems (City of Kingston, 2017). Sustainable developments including renewable energy systems or green infrastructure which supports resilience and sustainability can also be named as a community benefit in certain municipalities (City of Kingston, 2017). By increasing heights in key areas, municipalities have the ability to integrate these strategies into up-front expectations for Section 37 benefits in key areas. This provides the opportunity to create nodes for density where specific Section 37 requirements are necessary to build at a certain height. This will be further discussed in the Regional Plan Recommendations.

Improving Mobility in Urban Intensification

Through the analysis of urban intensification it is clear that these developments have access to facilities through walking, but are not necessarily walkable, mixed use communities. Walkability can be introduced through street design, traffic calming measures, decreased front yard setbacks, increases in mandatory street frontage, mandatory floor heights and integrating mixed use into development.

Limitations of Mixed Use and Strategies for Flexibility

In terms of land use strategies, mixed-use is often the 'go to' method of integrating walkable places in urban areas. The result becomes much more complicated. As developments are strictly required to have retail on the ground floor, the retail market does not always catch up and often there can be an over-saturation or a lack of interested tenants involved. This sometimes results in 'neighbourhood mixed use', which includes tenants such as dentist offices or pharmacies. The discussion around this topic seems to hover around flexibility. Planning documents often create land uses which guide development to create communities from scratch, but this is not always possible. This requires an existing community, which currently shops at cheaper large box stores using vehicular transport, to adapt into a community that walks to their local amenities. Where this is possible, it is still not an easy nor instant transition. Mandatory regulations for mixed-use should not put developers or business owners at risk through the process. While mixed use should be encouraged in mono-functional areas, there should also be a level of flexibility for future transition into mixed use. This could be achieved by including mandatory ground floor heights and sizes, which may be used for residential amenity in the interim. Allowing flexibility for the retail market to fill in flexible ground floors has a higher likelihood of promoting natural growth of mixed use, rather than forced retail ground floors.

Taking Advantage of Existing Communities

An additional strategy is to encourage intensification in areas which already have a sense of walkability, a sense of place, and an existing network of community amenities and mixed-uses. These areas can include existing urban development centres, but also can include areas abutting historic main streets and local BIAs. While new development should be sensitive to local character, there are often missed opportunities for increasing density around these historic downtowns which already attract residents around the surrounding neighbourhoods. Increasing the population in these areas can strengthen local business, work off an existing walkable neighbourhood, and also create a more vibrant local centre to attract more residents to urban areas throughout the process.

Transit Access

The GTA has not been historically known for regionally planning growth and transit in a cohesive manner (Birnbaum & Millar, 2015). Currently, Ontario does not employ specific tools or legislation that require growth planning and transportation investment decisions. There is a clear issue with this practice.

> *"The Province's three key growth management frameworks – the Growth Plan for the Greater Golden Horseshoe, the Greenbelt Plan, and the Big Move – are intended to manage this growth. The first two of these three plans are currently under review through the Co-ordinated Land Use Planning Review process. While coordination is happening at the staff level, Metrolinx's review of the Big Move rests outside of the coordinated review process that is currently underway." (Birnbaum & Millar, 2015, p. 2).*

According to Ryerson's City Building Institute, planning must be aligned to growth management and transport investment with more transparency (Birnbaum & Millar, 2015). This can allow municipalities to commit to more transit-oriented densities and land uses in appropriate timing throughout the implementation of the plan. Regional Growth Planning, Transit Planning and Greenbelt Planning should be incorporated together, as they are inherently connected.

While this disconnect between transit and growth planning remains, the growth centres proposed are mostly abutting GO transit stations. Still, there is another, more impactful commonality - the directly adjacent highways that also abutt 'transit oriented' growth centres. Not only does this encourage vehicular use, it also decreases walkability within these urban intensification areas. These sites have been chosen for intensification, but there are also other transit stations which have less vehicular access, and more walkable surroundings which could also be fit for redevelopment and have not been considered within updated zoning bylaws.

Instigating Local Food in Urban Intensification

The regional food system becomes a difficult problem to affect, especially on the scale of growth and land use planning. Often communities and municipalities do not have the tools necessary to make these changes (Deloitte, 2013). There are still methods and partnerships which can be leveraged in order to make a shift towards a more sustainable food system. In each level of government, there is a set of responsibilities to implement a policy framework which can help municipalities put local food at the forefront of health.

> *"Cities regulate food sales, provide business licenses, carry out food safety inspections, support community gardens and provide allotment garden spaces, promote healthy eating, offer breastfeeding support, run nutrition education programs, fund school food programs, serve food in childcare centres and seniors' homes, provide social housing, fund dental clinics for low income families, support the growth of food processors and retailers, apply zoning rules, coordinate food festivals and events, and more." (Deloitte, 2013, p. 20)*

The region can employ many best practices in order to establish food policy councils and develop solutions to food issues. Urban Local Food Production

Food management elements	1. Producing	2. Processing/ preparing	3. Distributing	4. Retailing	5. Consumption	6. Waste management
Local food strategy and macro policy	• Food charter and strategy to confirm municipal priorities, objectives and goals • Official plan to guide the zoning by-laws • Economic development policy, including agricultural and employment factors • Public health policy, including food security and access • Environmental and sustainability policies • Integrated approval processes					
Food chain policies	• Planning polices and zoning by-laws • Planning policies and bylaws to protect agriculture land and uses • Planning policies to support small/ mixed-use farming	• Planning policies and zoning bylaws that allow value-added activity on agriculture land (e.g. washing, packaging) • Permitting rates • Incentive programs (e.g., tax increment grant and matching contribution for feasibility study)	• Procurement policy to include local food requirement	• Permitting rates • Permitting process for markets	• Zoning by-laws to allow value added businesses on agricultural land (e.g., bed and breakfast) • Signage	• Disposal rules and guidelines
Food chain programs	• Urban agriculture • Community gardens	• Processing facilities • * Mobile abattoirs • Community abattoirs • Incubator kitchens	• Procurement (e.g., farm to institution) • Food hubs	• Farmers' markets • Mobile vendors	• Branding • Quality assurance • Promotion • Tourism • Education & awareness	• Composting • Gleaning
Partnerships & governance	• Regional partnerships between municipalities to achieve economies of scale and political clout • Public-private partnerships to foster local agri-food businesses and promote local food to consumers • Partnerships with Non-Governmental Organizations (NGOs) to organize and maintain community programs • Multi-stakeholder partnerships to promote local food • Food policy council to drive policy recommendations, implement and oversee programs, and bring stakeholders together					

*** Note that some practices that have worked in jurisdictions outside of Ontario are currently not supported by existing Ontario policy or regulations. Further policy and regulatory discussion is required before these ideas will be viable options in Ontario.**

Figure 138 Planning and Policy Roles in the Food System. Source: Deloitte, 2013

Numerous community groups, multi-scalar incentives, and organizations have come together to practice urban agriculture and establish community gardens through Ontario's Local Food Strategies as well as municipal food strategies and grassroots movements. Still, more can be achieved in preparing planning policies and zoning bylaws to increase the ease in which communities instigate and implement this type of development (Deloitte, 2013). This can be done using the Regional Plan to develop municipal guidelines for incorporating agricultural land production and local food production using the Official Plan for general land use planning and bylaw goals (Deloitte, 2013).

Urban Intensification and Local Food Processing and Distribution

Urban Intensification often is developed on transitioning commercial or industrial lands. When transforming industrial lands, the integration of food processing plants should be considered within new development. According to OMKN, the best practices in distribution include public sector led procurement policies and food hubs (Deloitte, 2013). "Food Hubs are organizations that manage the aggregation, distribution and marketing of source identified food products from local and regional producers and processors" (Deloitte, 2013, p. 23). In terms of local businesses, often practices for retail include farmer's markets and vendors. Many farmer's markets in Ontario allow an affordable opportunity for farmers to market a direct outlet (Deloitte, 2013). There is also more which can be done to integrate Ontario-based grocery stores into communities as well as to market these facilities to the surrounding community.

Urban Intensification and Local Food Consumption

Of course, within Urban Intensification it is vital to offer food stores accessible by foot within a walkable community. More than this, consumption can be changed through marketing, public awareness, and the choices made by public-sector and touristic facilities (Deloitte, 2013). The recent topics surrounding Healthy Urbanism also assist in creating awareness around public health and local food.

Energy Projects: Renewing Electrical Infrastructure and Introducing District Energy

Taller and more compact development has been introduced into areas of urban intensification. This already increases the efficiency of heating in units and limits the amount of infrastructure necessary for development. But the compactness and density also allows for newer, more energy efficient infrastructure projects. In addition, the infrastructure in the built up GTA is aging and has reached its capacity for demand (Singh, Roy, Spiess, & Venkatesh, 2015). The increasing levels of customer participation in the planning and operation of the electrical grid is anticipatory. Allowing the community to participate in new energy solutions could result in new energy projects with new development (Singh, et al., 2015). A regional analysis of the energy infrastructure developed to identify key district energy development sites should be used to inform municipalities to generate density planning and density bonuses based on the opportunities for district energy projects.

Planning Policy for District Energy

In order to account for systematic implementation of key district energy sites, land use planning is imperative for achieving goals for infrastructure and energy. Urban form, density, and land uses can integrate incentives and plans to illustrate the opportunities for district energy systems (King & Bradford, 2013). The planning of district energy systems can start as high-level as a regional plan or regional recommendations - these recommendations can turn into more detailed direction with Official Plans, then secondary/community design plans (King & Bradford, 2013). The decision making around these specified areas can be collectively decided through consultation with developers, communities, and professionals in order to recognize the feasibility of the energy system in connection to a serviced area (King & Bradford, 2013). This could include involving a large thermal user as a catalyst or using a large cooling centre as a source of residual (wasted) heat (King & Bradford, 2013).

Through the encouragement of new energy systems through the Regional Plan, municipalities have more reason to work together on a larger scale network, not only within the existing boundaries. The regional plan can include energy mappings which outline potential heat sources near heat sinks and the ideal locations for dense developments when considering the energy potential for infrastructure. The regional plan which then guides the Official Land Use plan can then result in Zoning By-law to capture potential land uses for energy infrastructure in municipalities (King & Bradford, 2013). "Community improvement plans, zoning activities, and powers of subdivision offer the opportunity to review district energy" (King & Bradford, 2013, p. 23). For example. The City of North Vancouver requires all new development applications larger than 1000 m^2 to connect to the Lonsdale District Energy Corporation system (King & Bradford, 2013). This relationship offers more efficiency and similar to the Section 37 policy, developers receive density bonuses to increase profit margins. Of course this is not always possible, and feasibility studies are always run as part of the site approval process (King & Bradford, 2013). A regional perspective in planning and collaboration with the hydro and natural gas authorities has the potential to instigate a meaningful system with key target areas for new energy projects.

The introduction of rental based housing only increases the potential of district heating. When a property is managed by the same owner long term, the management and benefits of the energy system becomes more organized and more efficient.

Ensuring Buildings for Efficient Energy Systems

As previously stated, developments which are above a certain floor areas may be subject to a certain percentage of energy efficiency or infrastructural funding commitments which would be part of the up front development requirements for sites. Beyond this, new buildings should focus on central heating systems, rather than point of use heaters (King & Bradford, 2013). In addition, buildings should have more standards and incentives which promote green roofs and energy production of roofed areas.

Ecosystem Services in Urban Intensification

A discovery within the analysis was that more people within urban intensification areas have more access to open spaces and parks by foot. This has primarily to do with the increased walkability with urban intensification areas and the higher densities which reside within them. An analysis of ecosystem services has offered much more into understanding the value of the natural ecosystem to manage the urban and rural environment, but also increase the quality of life for residents. Here there are two connected opportunities: to connect more density to natural networks and while doing so, improve the network of Ecosystem Services in the GTA by increasing standards for development near floodplain areas, widening the ravine network, creating east-west connections, and integrating building level water run-off management as well as biodiversity projects. Of course, municipalities already consider some factors for their green networks in their planning documents, but a more visionary regional response to multiple Official Plans is needed introduce connected green fingers and do more to create green networks beyond the ravine system and soccer fields. The improvement of the ecosystem networks are tightly connected to livability. Integrating more site standards for these developments provide opportunities for more attractive urban areas for families and a new range of demographics.

A Regional Vision for Urban Intensification

When it comes to Urban Intensification, a regional plan must firstly provide more guidance on HOW to create more developments within inner areas. This guidance should reflect upon municipal market regulations, as well as guidance on how to properly budget lands for future developments. This guidance should reinforce that an excess in Urban Intensification lands will instigate more necessary development in the region. These modest, mid-rise developments within the city should be budgeted through assumptions on the future conversion of suburban malls, mono-functional commercial areas, transitioning industrial lands near transit stations, and excess parking lots in suburban regions. By guiding development beyond a 60% requirement and beyond small-scale growth centres, land values can be more evenly distributed. This is not to say that growth centres should be diminished, but the concept of the growth centre can be shifted. Whereas the current growth centre is intended to create sustainable, compact city centres in the suburban region - a new type of growth centre could better achieve this. The new growth centre can be located in areas within municipalities which are suitable for higher densities, yes, but they also can be areas for increased sustainable development. Municipalities can use these areas to put forward transparent and up-front Section 37 'sustainability benefits'. If development seeks higher densities in certain zones of these growth centres, developers must provide specific infrastructure, transit access, reduced parking requirements, ecosystem services connections, affordable housing and so on. Following a regional assessment of energy infrastructure, food, and ecosystem services opportunities, these areas can be targeted for specific projects and improvements. This means that the locations of these growth centres **go beyond density and beyond numbers** - growth centres should be focused on integrating new sustainable projects in increasingly dense suburban centres.

Figure 139 Housing at Frederikskaj, Copenhagen, Denmark Source: Bustler

15.2 Inner Ring Expansion Recommendations & Policy Implications

Inner Ring Expansion: Lowest Performance & Highest Amount of Development

The analysis of Inner Ring Expansion in the research affirms the common understanding that classic suburban subdivision design has resulted in lowered sustainability based on the indicators used. The impact of this growth typology is increased considering that IRE accounts for the majority of the growth in the region. For years, there has been a clear call to reduce the amount of this type of development. The main fuel for this change focused on the expansion into agricultural land and the increased demand for infrastructure created by an inefficient urban form. This instigated the use of Smart Growth and New Urbanism in planning and governance policies. As stated in the report, these concepts were focused on 20th century issues in planning and not the problems of the 21st. Nonetheless, the policies surrounding density and reduction of expansion have reduced the area of expansion compared to late 20th century development. Despite this, the analysis of the growth typologies has pointed out that the 'unsustainable' performance of IRE is actually more complex than agricultural land conversion and sprawling infrastructure.

What makes matters more difficult to comprehend, is that IRE is losing its ability to create affordable housing. The need to provide affordable family housing has been at the centre of the 'pro-greenfield' debate for many years. As land values are increasing in the GTA, it becomes difficult to justify building ground-oriented subdivision housing on high value lands to provide 'affordability'. In addition to creating changed market regulations, changing densities and taking advantage of housing typologies on greenfield lands may allow even more affordable housing, with less push back from NIMBYism than in Urban Intensification areas. New housing typologies have already been disrupting the market and changing the way we develop greenfields. Given the location and 'simplicity' of developing greenfield lands (comparatively), there is more opportunity to provide meaningful changes to this growth.

It is clear that, just as affordable Urban Intensification should be increased, IRE should be generally reduced. Regardless, the attempts of reduction (beyond densification) have thus far had a low impact on the sheer number of homes being developed in subdivisions and the resulting sustainable performance. Therefore, while reduction must occur, there must be a higher standard of development required for sustainability. Greenfield development is an unavoidable form of growth and regulations must be used in order to control the type of growth and balance the negative effects of land conversion and subdivision design on sustainability and livability. Planning policies and regional design cannot act alone. Market Adjustments are necessary to level the playing field between IRE and Urban Intensification by creating development costs (DCs) and property taxes which reflect the true costs for municipalities and tax payments. After municipalities and regions can adjust their payments for developments in a consistent way, planning regulations can be used to focus on more sustainable design strategies as outlined below. To reiterate, there are two basic goals which IRE must achieve to create a more sustainable region: a reduction of development through market-driven and regulatory approaches and a change within the patterns of greenfield design which are also shaped by market changes and planning regulations. The idea is to level the playing field. When it comes to cost, it should not be less expensive to create unsustainable growth typologies which are subsidized by more sustainable urban development.

Reducing Greenfield Development: Market and Planning Regulation Approaches

The Market Approach

Past attempts have taught us that regulatory planning approaches alone do not work to curb sprawl because they insufficiently acknowledge the financial and broader economic forces that drive urban development (Blais, 2010). Pamela Blais outlined in her book, Perverse Cities, the necessary market changes that must be addressed evenly across regions in order to curb greenfield growth. As Blais states, "Fiscal policy can have a pronounced effect on urban form and the attainment of municipal planning objectives for more compact, efficient development. The reason this comes about often has to do with the fact that municipal financial policy is often developed in isolation from planning policy. These two streams need to be considered and developed together, through higher levels of integration between financial advisors and municipal planners" (Blais, 2010, p. 219). Throughout the book, Blais acknowledges the incentives which are commonly disincentivising urban intensification while increasing benefits for Inner Ring Expansion. Some key areas must be addressed before spatial planning takes effect. Without addressing these market regulation issues, planning regulations are more likely to inflate the housing market than assist within their development. The following are services which are often subject to 'misincentives', where urban development is subsidizing greenfield development:

- Property prices for land and buildings
- Mortgages and Mortgage Insurance
- Parking, Gas, Car Insurance
- Hydro (Electricity) and Gas
- Other Utilities
- Water, Sewers, Roads, Garbage Collection, Recycling, Snow Clearance

The following is a summary of some of the selected tools and strategies outlined in the Perverse Cities which are applicable to regional planning and organization.

Structuring Smart Development Charges

Currently, development charges (DCs) are not reflective of the actual cost that municipalities pay for services and infrastructure (Blais, 2010). This has created an unfair bias where denser, more efficient development within urban areas are being charged more for DCs than greenfield low density designs. This is because most DCs are charged for unit types, not by the location of the development. The solution lies in altering the design of DCs across the region in order to create an efficient allocation of resources that reflects true costing - this means prices would vary by location, development patterns, and types of uses (Blais, 2010). This has been used in other cities, such as the City of Ottawa, where there are three zones of development including inside the greenbelt, outside the greenbelt and rural (Blais, 2010). These classifications could be expanded upon, but are the beginnings of creating more balanced opportunity and changing the forms of developments. By also including development pattern and type of use into consideration, developments already on greenfield lands can choose to improve urban form to significantly reduce the effects of expansion. Basing the charge on land area and actual costs can allow for a sort of flexibility for developers to change housing typologies to balance cost benefits. Blais states that a key element of this strategy is remaining transparent and keeping in mind the context of different locations (2010).

Property Taxes

Blais also suggests property taxes should also be applied based upon the location of the development pattern and that land use-related cost variations should be applied to services whose costs are influenced by these factors (Blais, 2010). This could link taxes to 'cost causation' where urban form factors influence cost paid. Whereas other taxes do not refer to the development pattern, these should have a different relationship incurred. The author also suggests that property taxes should not be based upon buildings but upon the land itself (Blais, 2010). This is due to the disincentives that exist for areas of urban intensification where lands are taxed based upon their value (aka apartments having a higher value due to unit numbers and allowable height). By changing property taxes to being based on the area of land, there are more incentives for achieving the maximum density allowed in the zoning bylaw.

Targeted Subsidies

Rather than supporting many individuals and groups which don't require subsidies for development, these subsidies should support fair and effective services (Blais, 2010).

Planning Regulations Approach to Reduce IRE

Changing to Proactive Land Needs Assessment and Land Budgeting Methods

IRE has the reverse issue to Urban Intensification when it comes to accommodating lands for development - there is arguably too much allocation for it. Many municipalities make assumptions on the type of development which will occur in future urban development based on the existing situation and establish greenfield lands and boundary expansions to accommodate this change. Boundary expansion occurs if a municipality can demonstrate that it is not possible to accommodate future growth through the existing context of the built boundary or existing greenfield lands (Haines & Aird, 2018c). The process occurs through a Land Needs Assessment application. The land needs assessment is used to determine the quantity of land which is necessary to account for growth (Province of Ontario, 2017). This is where municipalities can create a decision on whether to expand the boundary of settlements and increase the amount of greenfield development land (community areas) and Employment areas.

According to Ryerson University, most planning documents have outdated assumptions about land budgeting within this process and land within urban built up areas are not seriously considered for development (Haines & Aird, 2018b). Currently, municipalities practice land budgeting for Land Needs Assessment, which allocates lands which they assume will be necessary based on the current situation of development. If municipalities are assuming that the incoming population will seek to live in single-detached homes, they will consider a larger amount of greenfield land to be requested (Haines & Aird, 2018c). These assumptions do not consider the changes that have been drastically shifting the housing preferences in the GTA, including the decrease in the development of single-detached homes due to rising unaffordability (Haines & Aird, 2018c). This is where the 'reactionary approach' fails to create an ideal situation to change the forms of development in the region by basing new patterns on old patterns.

There is a possibility to introduce an optimized process which could prioritize the goals of municipalities and create more guidance for inner city land analysis (Haines & Aird, 2018c). According to a recent report led by former mayor David Crombie, to create a more ideal situation for development, the province needs to develop a uniform and transparent method for municipalities when undertaking land budgeting exercise which will model different expansion scenarios, including a no-expansion scenario to understand the current state of available land in the region (Haines & Aird, 2018c). This includes "an activity-based approach" which looks at the opportunities on real development parcels which are within the built boundary (Haines & Aird, 2018c). A Regional Plan should support and guide municipalities on guidelines on how

to budget urban areas for parts of their land development, and include a more visionary process for inner development within their official plans.

Sustainable Greenfield Development: New Urbanism, Landscape Urbanism and New-Ruralism Approaches?

While there is a substantial challenge in providing less greenfield development, perhaps there are more opportunities which are available to change the regulations for classic subdivision design. The single-family home is already dwindling, while newer, more compact developments are underway. The Premiere of Ontario attempting to increase the amount of single-family units through Bill 108 may just as well be promoting a dying coal industry - tastes are adapting and planning must take advantage of this fact. Developments now include moderations of townhouses including stacked towns, back-to-back towns, or stacked back-to-back towns (or virtually, just apartments). Capitalizing on these changing housing typologies gives new abilities to achieve a more livable space, moderate the types of subdivision layouts, and create an affordable way to manage housing growth in IRE areas. A Regional Plan should provide guidance on how to design using these densities and typologies, beyond just land use plans. There should be an efficient transition from single family housing networks to a more complex type of housing which can change the layout of our greenfields. For example, below is a development containing stacked back-to-back townhomes with interior parking per unit in Wateridge Ottawa. This design is provided by Minto Housing group, one of the largest development companies in Canada. The danger in allowing free development of these typologies remains in the fact that the monotonous and repetitive housing with a lack of mixed use and integrate amenities threatens to develop high densities in very disconnected development and form.

Changing The Practice of Subdivision Approvals

A plan of subdivision is needed in order to convert greenfield land into lands for development. It is specifically needed when dividing a piece of land into two or more parcels and odder one or more for sale (Subdividing) (Province of Ontario, 2018). This is where measures from the Provincial Planning Act are necessary to continue with the process of approving these plans. According to the Province of Ontario, subdivision approvals ensure that land is suitable for its proposed new use, the proposal conforms to the official plan and zoning in the municipality, and neighbouring citizens are protected from strains on municipal services and inappropriate development (Province of Ontario, 2018).

In considering a plan of subdivision, the approval authority evaluates the merits of the proposal against criteria such as:

- conformity with the official plan and compatibility with adjacent uses of land
- compliance with local zoning bylaws
- suitability of the land for the proposed purpose, including the size and shape of the lot(s) being created
- adequacy of vehicular access, water supply, sewage disposal
- the need to ensure protection from potential flooding

The next step in the process is the draft approval. Conditions of Draft approvals include road widenings, parkland requirements, rezoning of the area to reflect the new uses in the subdivision and other requirements (Province of Ontario, 2018).

Changing the conditions for subdivision approval is an opportunity for principles and spatial regulations within the Official Plan and Regional Plan to be implemented into greenfield development designs. Whereas a more structured, sustainable design, can be used to approve or create necessary changes to subdivision design. This can be captured by creating a larger suburban/greenfield vision within Regional Planning documents which actually connects developments across regions and municipalities.

Figure 140 Wateridge Housing Render, Ottawa. Source: Minto Homes

First Identifying Sustainable Neighbourhood Qualities Through Design

A Regional Plan should also create guidance on how designs can and will drastically increase efficiency as well as increase the quality of life quality in these areas. This should be done through design guidelines, as well as mandatory design conditions which should identify what sustainability is in greenfield development, beyond individual energy efficiency. This should create incentives for "energy efficiency" which must be redefined to mean not just the energy efficiency of individual buildings, but also of the building in a specific urban form and context. This could constitute as a classification similar to LEED ND. Again, incentives can only come so far. There must be increased regulations and policies which demand more sustainable development in the coming times. In contrast to Urban Intensification developments, Inner Ring Expansion must be forced to adapt to a more sustainable form through market and planning regulations.

Local Food: Realities of Preserving Agricultural Land

Many of the qualities necessary to improve the local food system through planning has been outlined within the recommendations for Urban Intensification above. Here, we will further discuss the aspects which are more relevant to the IRE context, meaning the reduction of agricultural land conversion and the integration of local food systems in a different context. As already stated, with changing densities and housing typologies, the amount of greenfield land which has been designated in the 'Whitebelt' is arguably larger than necessary. For many municipalities, this action cannot be undone, but the way we develop these lands can change to reduce the land conversion impacts and maintain some of the agricultural land in the region. This should not be an act of meaningless preservation, which does not consider the realistic situation of farmers in the region. There must be consideration of farmer's private rights to sell their own land. There are 2 fundamental ways which planning can reduce the consumption of agricultural land in IRE. The first is to reduce the amount of payments which farmers are providing to the municipality. Cities can regulate the taxes which are placed on farmland and create incentives for farmers to be leveraged in order to not need to sell land in the first place. Farming is a challenging industry to maintain, and many farmers do not have the ability to save for the future and can often have secondary and tertiary employment (Bunce & Maurer, 2005). According to Bruce & Maurer, many farmers in the GTA will depend on the sale of land in the future for their own long-term stability. In addition to promoting local food hubs, farmers markets, and other local food campaigns in settlement areas, municipalities need to do everything in their power to avoid disincentivizing local food production in their greenfield areas. The second, more reactionary, approach to farmland preservation is to integrate existing farmland into new development. This is a drastic change, whereas development currently completely converts farmland into new developments, leaving all of the land converted to housing or

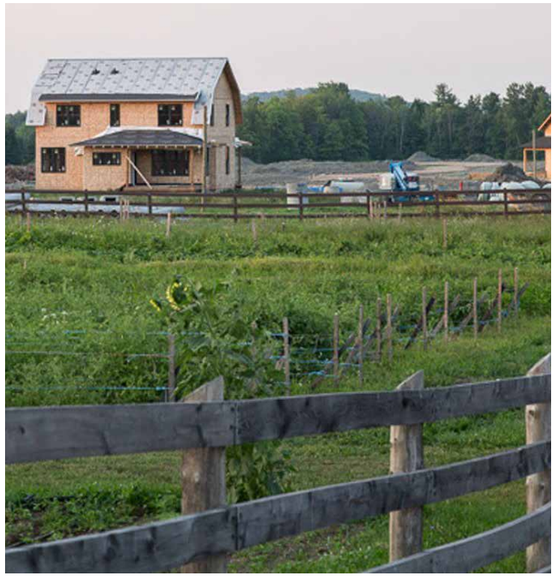


Figure 141 Hendrick Farms, Old Chelsea. Source: Ottawa Magazine

Figure 142 Hendrick Farms, Old Chelsea. Source: Ottawa Magazine

parks. Yet, this change is possible, given the correct regulations are maintained. Currently, when farmland is purchased in the GTA, it is common for the farmer to continue leasing the land before development (Bunce & Maurer, 2005). It is possible that more entrepreneurial farming industries may continuously lease out lands which are integrated into developments (Bunce & Maurer, 2005). This could create a successful business model for food production which functions better adjacent to existing communities such as pick-your-own or vegetable/fruits greenhouse production. This production not only creates more initiatives for local food consumption, it also creates opportunities for direct partnerships between production, distribution, processing, and waste.

There are multiple benefits for incorporating farmland into development. The surrounding agricultural landscape is something which draws people to move to the outer suburbs and creates a significant cultural value. As we expand outwards, communities are losing the very amenities which they sought out in the first place. This central farmland amenity in new communities can create areas which instigate more density, more buyer/rental interest more community benefits. This also promoted the participation in agricultural, similar to the visions of Agrarian Urbanism or New Ruralism.

This could be a successful alternative to the current suburban vs. farmland practice taking place today. Rather than continuing the disconnect between planner's ideas on farmland and farmers' rights and wellbeing, integrating permanent farms into development lands can create a more sustaining land use for the future and create recreational connections along the way. Above (Fig 141 & 142) is a development example of just this: suburban growth which integrates agricultural land into development and connections to existing local food producers. It is a development in Old Chelsea Quebec, close to the city of Gatineau and Ottawa (Scott, 2017). The development is a, generally low density, development which has integrated the existing farmland into the community with collaborations with local farmers and the previous land owners. The area is within walking distance of many amenities, local food distribution retailers within the main street, and also has a closely abutting National Park Trail system. Each cluster is designed around a common green space that is connected to a natural playground and an organic farm (Scott, 2017). With the focus on livability and community lifestyle, the development 100% of the units purchased four years before the first house was ready in October 2016 (Scott, 2017). 1% of the funds from a purchased house will be invested into a trust fund which holds the money for future necessary developments for the farm (Scott, 2017). Future purchasing will continue to maintain this funding system (Scott, 2017). A grandfathered one time fee is attractive to purchasers, rather than a monthly condo/co-operative fee which is subject to change.

Already 76 neighbours have bought into a community-supported agriculture program where crops are delivered to patrons weekly. The farm also supplies two local restaurants with produce. While house building has yet to begin in earnest, 21 homes have been sold and the farm has been up and running for over a year. Last fall, 12 volunteers helped plant 4,000 garlic bulbs in two hours. The same farm produced enough parsnips to provide a 1,000-pound donation to the local food bank. All of this occurs on a seven-acre farm. One of the remarkable features of this plan is the enormous productivity that is being achieved on a small piece of agricultural land. While the idea of intensifying the planting and production of a farm is not a new one, Hendrick Farm proves that it can work. (Scott, 2017)

It is important to note that this example has also created a development which is targeted towards higher income families, and is not in close proximity to transit or more significant amenities. This is more due to the unit sizes and housing quality, than the layout of the development itself. The qualities within the development can still be used as a precursor for future possibilities of greenfield development in the GTA.

Farmland integration is an idea which seems unattainable, but arguably, is not significantly different than provisional park area regulations in suburban developments. Through consultation with developers, farmers, and community volunteering and funding initiatives, it is quite possible to develop in this manner.

Mobility

Improving Mobility in Inner Ring Expansion

On average, IRE performed the lowest when it came to mobility out of the three development typologies. As noted previously in the document, there is a lack of walkability, mix of uses, and an inability to integrate public transport into developments. There are of course many design solutions which could make a difference within these networks, but there is a key consideration which is necessary to create change - integrating a secondary regional network for transport in the GTA into the structure of IRE developments. The plans for secondary transit lines are key when considering future designs for these regions. While GO train stations provide North-South access within the GTA, East-West connections are few and far between. This has created a system where most commuters which work outside of Municipal Toronto drive to work by car. Metrolinx has of course factored this into their future plans by creating future rapid transit/tram connections for areas of IRE. Nonetheless, these transit developments should also be met with more efficient land uses and development patterns. Density along transit lines can not only create access, but also increase ridership and funding of rapid transit in suburban regions. This integration is not possible without getting serious about walkability in IRE. This can be achieved with an increase of intersections, walking paths, and connections to real amenities. This continues the discussion on the possibility for mixed use. In these areas, mixed use should still be strategically integrated with flexibility, but it is more crucial to integrate multi-functional buildings to increase walkability and reduce care use.

Energy: Taking Advantage of New Infrastructure

Many of the same principles for energy planning in Urban Intensification remain consistent in greenfield developments in terms of what municipalities can do to incentivise and encourage efficient energy infrastructures within Official Plans, Zoning Policies, and Section 37 guidelines. The significant difference is the fact that new infrastructure must be introduced within new developments in IRE. Currently, these infrastructural projects do not reach for improvements within the demands on the energy systems from ground-oriented developments. Creating new infrastructure should provide municipalities with the incentive to introduce more efficient heating and energy systems. An especially key opportunity is the introduction of district heating into greenfield developments. There is a large potential within these projects to reduce the use of natural gas in the region. A centrally heated network can be powered through electricity from the grid, renewable electricity, or from biogas building from the region's already progressive compost collection services. Not only can a district heating network drastically decrease natural gas usage, it can also be used to heated sidewalks and public spaces. These walking networks could drastically increase the amount of pedestrian access to secondary and primary transit stations in the winter months. Actually funding these projects will come down to true costing from developers. As developments are paying fair fees for these services, municipalities should factor in the necessity of a new regional heating network in all sites which are applicable. A Regional study on the possibilities for geothermal and regional heating systems should be applied to a regional design vision for greenfield developments.

Figure 143 Sidewalk Iceland District Heating System. Source: Heated Sidewalks: Iceland has them, Saskatoon Wants Them, CBC.

Ecosystem Services in Inner Ring Expansion

Many 'pro-greenfield' debates claim that the biodiversity in greenfield development is higher than in urban areas. The same can be said for an increased amount of porous landscaping creating reduced risk for heat islands and urban water runoff. In a black box situation, where we only review the current state of urban form, greenfield subdivisions would likely fair better that urban intensification for providing ecosystem services. Nonetheless, we are not in a closed system. Inner Ring Expansion and Urban Intensification both convert existing land uses, but IRE converts a land use which had some value to the surrounding landscape. This is not to say that agricultural land is truly vital to ecosystem services, as many have argued the opposite, but converting agricultural land to urban uses only expands the urban built up area. This built up area is directly adjacent to previously rural forests and wetlands. These systems must now maintain a higher amount of urban runoff and pollution from new surrounding land uses. Some of which develop directly on a wetland.

Again, when considering the solutions for IRE, it is crucial to limit the expansion of urban development into these rural area ecosystems. But if some development may still occur, there are methods which can be used to reduce these impacts on the systems. Again, subdivision design must go beyond monotonous housing, mono-functional commercial, but especially it must move generic mandatory parklands. Far more can be done to integrate ecosystem services into new developments. This can be integrated into other changes called for in other design elements, such as a more granular fabric creating more green spaces mixed with more compact development typologies. IRE should not only integrate more systems on site, growth should also consider an increased consideration of floodplains. Especially for expanding growth, it is critical for a region to develop a strategy for floodplains. A basic first step is to update the existing floodplain areas to reflect the challenges of the future for these systems, then begin to regionally address flood management strategies, rather than individually managing water through conservation authorities which often have disconnected planning and funding.

Figure 144 Current Common Greenfield Development Subdivision Plans. Vellore Village - KLM Planning Partners Inc

A Regional Vision for the Inner Ring

Whereas Urban Intensification areas are the main focus in existing Official Plans and Zoning Bylaws, IRE is often identified with large swaths of generic low-density residential land classifications. It is assumed that these areas remain untouched by planners because of the standardized conditions of subdivision design by developers. Without many regional and local connections considered for design, these areas are primarily isolated and separated from surrounding lands and uses. Why must urban areas maintain connections, increase community benefits, and create a cohesive environment at greater cost, while its greenfield counterparts require a minimum amount of urban design quality? It is increasingly clear that subdivision design is inefficient and unsustainable, but it also creates a land form that is increasingly resistant to future changes and increasingly unaffordable. The network of individually owned parcels in a (seemingly) random set of road structures creates difficulty to ever change suburban areas into more complete communities. IRE in the GTA lacks clear structural guidance. Developing previously agricultural lands creates an expectation to build a community from scratch and creates clear issues for vision. Adjusting these designs to create a more connected quasi-urban network is a strategy to remediate current issues of sustainability. A regional network embedded in useful connections for infrastructural efficiency and amenities across the GTA could drastically increase the quality of suburban design. This does not necessarily mean cities should fall on New Urbanist principles to develop greenfield land. Communities which attempt to achieve a traditional and historically based layout and built for within new development often fail to achieve the complete community which was intended. It is possible to develop a compromised style of development which does not attempt to imitate communities which grew organically over hundreds of years. These designs should be embedded within the aspects necessary to obtain 'sustainability' as outlined above. For example, UNStudio's design for a master plan in Helmond's Brandevoort District introduces a flexible grid which can be developed incrementally. The area will explore social cohesion, health, new transport technology, and decentralized energy systems (Baldwin, 2019). Stakeholders in the GTA should not hesitate to compare these developments to subdivision designs in the region. It is possible to develop communities with the best intentions for new designs and uses without depending on the forms of the past while still encouraging multi-functional buildings, sustainability, access to transit, and walkability.

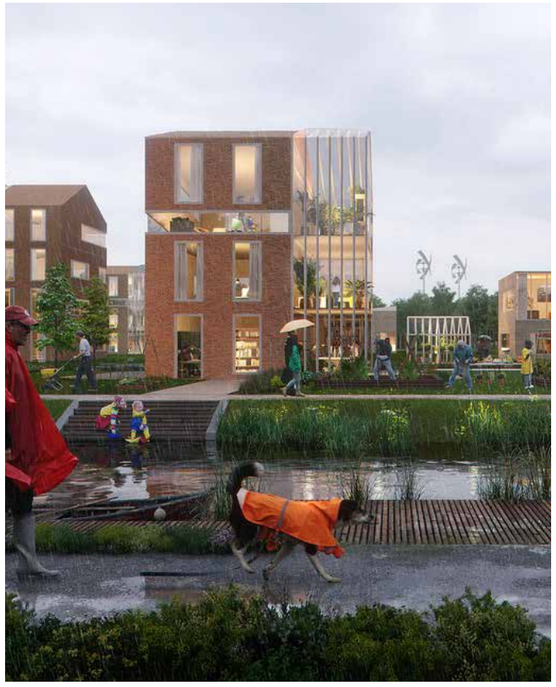


Figure 145 UNStudio Vision. for Helmond's Brandevoort. Source: ArchDaily.

Figure 146 UNStudio Vision. for Helmond's Brandevoort. Source: ArchDaily.

15.3 Outer Ring Expansion Recommendations & Policy Implications

Outer Ring Expansion

Much of the recent built form in the outer ring is similar to the subdivision forms within Inner Ring growth. Yet, the towns which they are expanding onto create a unique situation. The mono-centricity and small size of these rural historic towns matched with lower quantities of growth have allowed this development to maintain some quality which is lost in IRE. This has created an interesting 'middle' within the typological growth analysis. Interestingly, growth in the ORE often performed better than growth in the IRE. Outer Ring Development has expanded on an existing, generally walkable town centre with surrounding residential and the greenbelt on the exterior of the built up area. Nonetheless, the current successes in growth has little to do with the growth itself, but more the location which it has occurred. Houses remain in a traditional subdivision format with a lack of integration and mix of uses in the plans. The continuation of this type of growth will diminish the benefits which it currently has acquired by expanding beyond the limits of these small towns. This expansion will increase pressures on infrastructure, energy demand, the surrounding Greenbelt Ecosystem, public transport, and general services. But unlike IRE, there is a greater opportunity to develop these towns while still reinforcing qualities of a complete community.

Within this project's analysis, ORE was separated as one growth typology, but in reality, ORE is growing through Urban Intensification and through greenfield expansion on a smaller scale. Considering ORE is a virtually self sufficient settlement, the implementation of policies stated within the Urban Intensification recommendations and within the Inner Ring Expansion Recommendations should be considered. Considering this, this section of the recommendations will not repeat the same conditions for change, rather discuss the opportunities and challenges which are unique to this growth typology. This specifically includes the (unique) conditions for reducing expansion, for introducing a more resilient energy system, for maintaining small town walkability, and for maintaining local food distribution and production which is already relevant in these areas. If growth in the ORE can become more sustainable and build upon the existing advantages of the existing community, more growth can even be allocated to these municipalities. This will not only create more compact, complete communities, it can also reinforce the economy and community base of these regions. In order to address the existing opportunities and challenges in this regions there must be a context specific approach. Below are key elements which must be addressed with future growth.

Reducing Expansion into Greenbelt Fringes

As previously noted, many rural areas in the periphery of the GTA are experiencing growth. These historically rural communities are surrounded by Greenbelt Ecosystems and farmland. Much of the farmland in these areas is rented to farmers, but owned by parties looking to develop the land in the future (Ministry of Rural Affairs, 2014). The delay around this development is generally waiting for the province to relax its land use policies to allow for future development in these areas. According to the Province, rural communities hold that protecting these farmlands are vital for their communities and for future generations (Ministry of Rural Affairs, 2014). According to Neptis Foundation, rural communities in the Golden Horseshoe already have identified an excess of greenfield development lands than what is needed for their future growth. In these communities, growth is even minimal enough that many can accommodate all growth within the built up boundary area. These municipalities must withhold from increasing these greenfield areas into the Greenbelt and Whitebelt, and focus on land budgeting processes within their built boundary.

The Agri-Sector and Farming Communities

Again, much of the agricultural land surrounding these communities is rented by farmers or owned by farming industries (Ministry of Rural Affairs, 2014). Many of the opportunities for planning to assist in the local food chain remains similar to that noted in the Urban Intensification and Inner Ring Expansion sections (Ministry of Rural Affairs, 2014). What remains unique for the agricultural sector in these communities is that there is still a strong sense of the farming community within them, as they were historically farming communities. As seen in the analysis, this has created higher access to local farmers markets and small scale local grocers on the main streets/town centres of these communities. Since these communities already have a strong sense of local food and an existing food network, planning should reduce the restrictions on the community and encourage community involvement in improving the system. Increasing growth within these town centres will increase the access and participation to the local food community and create

Infrastructure and Energy Challenges and Opportunities

The infrastructure within these communities are often aging or unfit for future growth. This includes lack of access to natural gas, internet and water treatment facilities (septic/well systems) (Ministry of Rural Affairs, 2014). While this creates an increasing struggle for communities, it could also be seen as an opportunity to develop a more resilient system for the future. Funding from development fees, property taxes, and Section 37 bonuses can be targeted towards new energy systems for communities. It is inherent that these systems focus on resilient infrastructure. Currently, communities in rural areas are dependent on electricity networks which often have outages. Electricity outages become a major issue when many heating systems are electrical due to lack of access to natural gas networks. Providing systems which rely partly on renewable or neutral energy sources create an environment where outages become less impactful in the winter months, and less pressure will be placed on external systems. In addition, promoting intensification within the existing town centres creates opportunities to centralise infrastructural projects. Many communities have adjacent industrial parks within their built area to instigate business development and to deal with processing in the agri-food sector. Partnerships can be made within these large industrial centres for district heating networks, biogas production, and other shared electrical networks to instigate benefits in development.

Labour Shortages and Newcomers

Increasing the growth in these communities can balance the lack of the current labour force within these communities. This can include agricultural and industrial jobs which are the backbone of some communities. Rural communities have also been known to increasingly attract members of the creative class, as residents in cities begin to look for a more affordable base. Rural communities should take advantage of this advantages, and develop spaces for innovation and start-up hubs.

Accommodating Aging Populations

Whereas many of the areas in the GTA must address an aging population, rural communities have an especially difficult challenge ahead of them as there is an especially high ratio of elderly populations in these areas (Ministry of Rural Affairs, 2014). If aging populations seek to stay in these communities, there must be increased access to many of the amenities needed for such a demographic. In terms of housing, an increase of rentals and in care homes can be introduced into the centres of these communities, which ideally have access to local transport systems and to local amenities.

Rural Transit

This brings us to access to transit in these rural communities. Just as growth in the Inner Ring is difficult to service, rural expansion is beginning to present an even larger challenge. By expanding these communities, a small transit system has an even larger challenge. By increasing the intensification in the centre of these small communities, they can focus on improving their transport in these central locations. Maintaining walkability and small built up areas, the central node communities create an opportunity to connect train lines to the inner city in the future. These future satellite cities/towns can create even greater access to transit that Inner Ring Expansion Areas.

A Regional Design Vision for the Outer Ring

A regional plan/design for the outer ring should provide guidance on the development of these future communities. Specific communities should be outlined as key destinations for increased growth, given it acknowledges the growth conditions. These communities should be chosen based on existing infrastructural conditions and opportunities, the current and planned state of transit systems connections, the existing need for a labour force, and given the amount of land budgeted in the existing urban areas. The Regional Plan is intended to create sharper regulations on these communities in order to preserve their quality, but also increase opportunities for compact development and sustainable industry and infrastructure. Through the regional vision, these areas should become truly 'complete communities' and quasi-satellite cities in the future. This 'concentrated deconcentration' should increase access to more affordable lands in the region and enhance existing communities.

15.4 The Regional Plan

Spatial Regional Vision

The previous sections of the recommendations was intended to provide an explanation on how the different growth typologies could be changed through various planning and market mechanisms. This section is intended to provide recommendations for the regional plan as a whole. The regional plan is intended to build off of the successes and remediate the shortcomings of the current Growth Plan, by providing some key elements which have been established throughout the analysis and design studies.

1. Establish New 'Sustainable Growth Centres'

Whereas the current growth centre is intended to create sustainable, compact city centres in the suburban region - a new type of growth centre could better achieve this. The new growth centre can be areas within municipalities which are suitable for higher densities, yes, but they also can be areas for increased sustainable development. Municipalities can use these areas to put forward transparent and upfront Section 37 'sustainability benefits'. If development seeks higher densities in certain zones of these growth centres, developers must provide specific infrastructure, transit access, reduced parking requirements, ecosystem services connections, affordable housing and so on.

The intention of this section of research and analysis was intended to create guidance on how to locate and design these new growth centres. Within the analysis, it was made clear that aligning new growth centres with primary transit, historically existing walkable communities, possible regional energy networks (dependent on regional energy study), abutting ravine network systems and trail connections, and areas which can provide community services are more ideal than many of the existing growth centres to achieve the goals within Urban Intensification.

Based on the analysis and design provided in this study, recommendations for Growth Centre locations include:

Growth Centres are ideally Adjacent to:

- Primary Transit Stations
- Existing Walkable Communities and Historic Centres
- Business Improvement Associations and Main Streets
- Residual heating, regional heating, and geothermal opportunities
- Existing Ecosystem Networks and/or planned ecosystem connections (East-West connections)

Growth Centres Should Avoid Adjacency to:

- Major highway infrastructure
- Large suburban shopping malls replacing amenities
- Disconnected industrial centres
- Car-oriented communities and large scale road networks

Possible Mandatory Requirements

- A mix of units types and sizes
- A mix of owned and rental units
- Mandatory minimum ratio of permeable surfaces to hardscaping and landscape integration
- Mandatory community food investment
- Mandatory mixed use with retail units or flexible ground floors for future uses
- Mandatory community energy pool
- Mandatory 15-minute access to primary transit
- Mandatory reduced parking requirements

2. Develop a Vision for the Inner Ring

It is not a revelation that the Inner Ring lacks structure and connection, but more must be done to create a larger vision for such developments. The region should, at least, require improvements in development form (stated in the guidelines). A vision for the Inner Ring, based on secondary transit access, ecosystem services connections, a strategic mix of uses, the integration of a regional heat network, and community networks, can offer more structure to Official Plans when it comes to greenfield classifications and zoning. Further guidance on the actual forms in this growth will be addressed within guidelines on built form and sustainability
The form of the regional vision for the inner ring should be focused firstly on connections to the existing municipal centres and future east-west LRT lines. If the LRT/rapid bus transit station is to be developed in an adjacent Inner Ring Area, this may give structure to the outlying development. Without proper access to higher intensity transit such as LRT or BRT, the creation of a walkable suburb becomes an illusion. As stated in the previous sections, development of these areas can be based on the integration of agricultural land. While the actual structure of this integration will likely vary, there should be guidance on how to develop connections between these lands. This may create recreational trails and pathway systems which link to the existing ravine network and trail system. Creating a community where recreational trails and natural areas have walkable access should be key. Ideally, these transit networks and natural networks will create guidance for density bonuses, affordable housing, and mixed use areas. This brings us to the mixed-use high street areas. Many municipalities have attempted to integrate the of New Urbanism into their future plans. As below, one can see 'Cathedral Town' a development in Markham which has presented mixed use into suburban housing typologies, it is clear to many that, these retail shops are not often visited. As previously discussed in the document, building a New Urbanist development from an agricultural plot does not always go according to plan. More must be considered within development visions, including a market analysis, supportive densities, appropriate ground floor layouts, and other key factors. Planning these areas must of course require key amenities in walking distance (groceries, pharmacies, schools, clinics, etc), but integrating high streets may not always be ideal in the given context. Nonetheless, these developments should provide areas with potential for future mixed uses with appropriately scaled ground floors and space for parking capacities which, in the interim, may be used as residential amenities.

Possible Mandatory Requirements

- A mix of units types and sizes
- A mix of owned and rental units
- 15-minute access to transit
- 15-minute access to amenities
- Integration of net-zero land conversion (integration of ecosystem services and agricultural lands)
- Flexible ground floors in key development areas
- Integration of Regional District Heating Plan

3. Establish Outer Ring Communities for Targeted Growth

As noted in previous sections, outer ring growth communities present an opportunity to provide 'complete communities' which can be serviced by centralized transit, central amenities, and surrounding natural areas and systems. The existing conditions of these towns presents more opportunity than the current practice of outer ring expansion, based on the analysis and strategy development in this research. Many of these areas also suffer from an aging (retiring) labour force, and require emerging talents and an introduction of new economies. While all outer ring communities should follow the guidance set by the new growth plan, there are key municipalities which may accommodate more growth than allocated within the existing projections. Ideally, this could attract residents which would generally be attracted to the Inner Ring area.

4. Develop Connections for Regional Natural Networks

This section of the regional plan will integrate the planning and ideas established in the future plans outlined by the Toronto and Regional Conservation Authority in order to integrate them into land use planning and land conversion strategies. Programs such as the The Sustainable Neighbourhood Action Program (SNAP) will be considered for the future designs of the region.

An advantage of a regional plan for the natural networks is that it can consider broader access and importance of new connections in existing urban areas. While many residents may have access to an abutting section of the ravine system, residents who are located between these networks often face a winding series of subdivisions to walk to these areas.

Regional Guidelines to be Provided

1. Guidelines On Sustainable Development For Urban Intensification, Inner Ring Expansion, And Outer Ring Expansion Contexts Including:

- Walkability
- Mobility
- Energy Implementation
- Ecosystem Services
- Livability & Affordability

2. Guidelines On 'True Costing' For Development Charges And Property Taxes

3. Guidelines On Land Budgeting For The Missing Middle

4. Guidelines On Designing The Missing Middle

5. Guidelines On Agricultural Integration Into Developments

6. Guidelines On Rural Community Improvements And Intensification

Necessary Supplementary Studies And Plans To Guide Regional Plan:

1. Regional Energy Plan And Guidelines

2. Metrolinx Transportation Planning (Existing)

3. Updated Regional Floodplain Studies

4. Rural Community Opportunities For Growth Analysis

5. Implementation Indicators Assessment

The intention of these recommendations is to devise changes to the regional growth plan which may adapt to create a more sustainable region based on the findings within this thesis. The current growth plan attempts to create direct requirements for the types of growth in the GTA. This includes the regulation for 60% intensification and 40% greenfield development. In addition to this (often unmet) requirement, growth centres were also introduced into the region in order to allocate and instigate higher density nodes throughout the built up area boundary. The third, most effective condition, is the mandatory density which has been required in new greenfield development. As we have found in this thesis and through external research, this plan has been successful at shifting how the city has grown. Nonetheless, the assumptions which have been made between compactness and density, and sustainability have not been inherently truthful. While expansion into agricultural lands has reduced from the patterns of the late 20th century, the majority of growth remains in high density subdivisions which place increasing pressures on the urban fringe. Not only this, where there has been densification, such as in the designated Growth Centres, this has often not resulted directly in walkable, neighbourhood oriented urban centres.

Current Growth Plan Goals

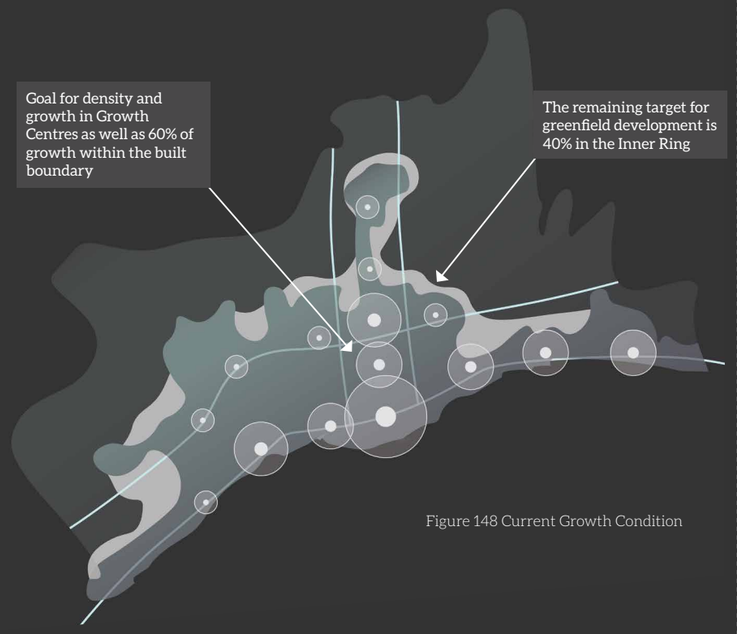


Figure 148 Current Growth Condition

Current Growth Condition

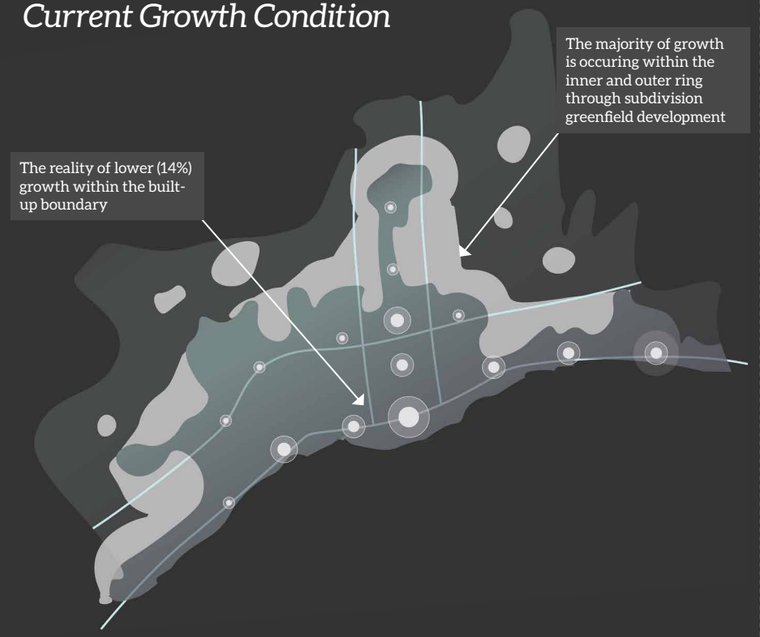


Figure 147 Current Growth Condition

Revised Growth Plan

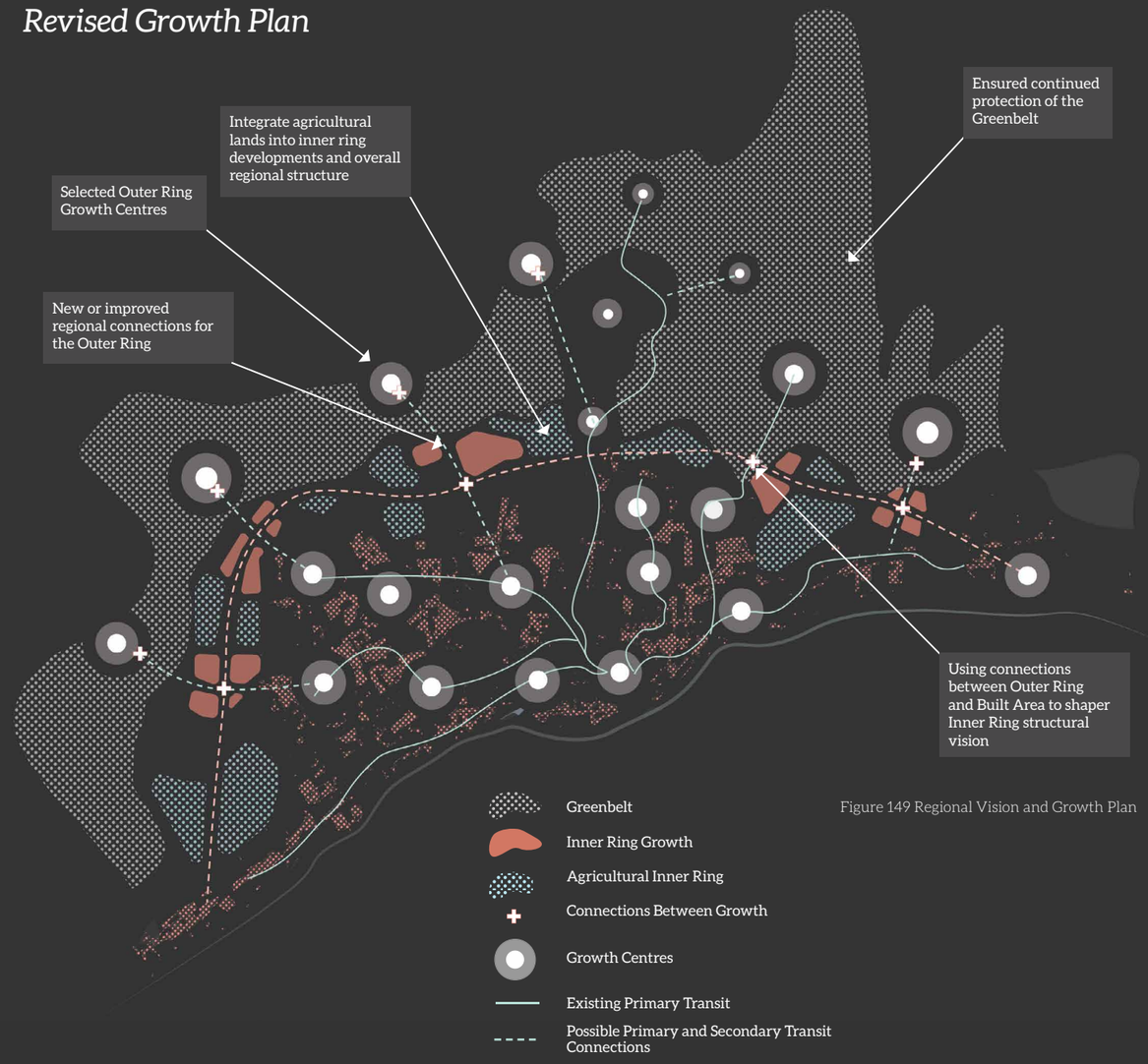


Figure 149 Regional Vision and Growth Plan

Figure 150 demonstrates the possibilities for a new regional growth plan. This plan focuses on firstly, increasing the lands which are budgeted for mid-density urban growth to accomodate for the missing middle. While increasing urban intensification was the central point of the growth plan, little guidance was given on how and where this intensification would occur beyond the growth centre. Here, the regional plan should provide guidelines on land budgeting for potential development lands within the urban area by identifying possibilities such as monotonous commercial lands and adapting industrial centres. Beyond the guidance on general urban intensification, the Growth Centres which are identified in Places to Grow, will be adapted to focus on more sustainable possibilities. The location assessment and possibilities for these central sustainable developments will be identified using the supplementary regional plans focused on food, energy, mobility and Ecosystem Services. As previously noted, up-front Section 37 zoning bonuses may be used to instigate higher densities in turn for sustainable infrastructure in these areas.

In the plan, growth centres have also been selected within the Outer Ring. These are the municipalities which have been deemed to have the highest potential for growth within their urban centres. By 2041, these areas should become highly self-sufficient rural-urban towns, specifically in terms of energy and local food production. In the future, the regional transit system should be better integrated into these communities, creating satelite cities in the outer greenbelt.

The concept of growth in the inner ring has been represented to symbolize a controlled and thoughtful approach to expansion. By using the connections implemented by growth in Urban Intensification and the Outer Ring, a vision is possible for the Inner Ring. By creating targeted primary and secondary transit connections these areas can be shaped around servicing, allowing for compact and higher densities, at a reduced rate of expansion.

Regional Plan Structure and Implementation

The successes and shortcomings of the Greater Golden Horseshoe Growth Plan have been discussed throughout this research report. The extensive 2-year consultation with the Province, Municipalities, and stakeholders for the plan created fruitful discussions and goals for the future in the Places to Grow plan. A new regional plan would attempt to build upon the structure and implementation of these policies.

Firstly, regional planning in Greater Toronto or the Greater Golden Horseshoe must be practiced by a regional body. Currently, the Ministry of Infrastructure for the Province is responsible for developing the Growth Plan. The Provincial involvement in decision making for the region makes the effect of governance changes that much more significant. This is increasingly questionable when considering that other Ontarian cities, even Ottawa (the capital of Canada), have not been subject to regional planning practices run by the Provincial government. Regional Planning and housing availability has become a politicised issue through the body which promotes the plan. A similar discussion can be had for the involvement of Metrolinx and other regional bodies. The weight of elections can already be seen in discussions being held by the current Ford government, with the proposal of Bill 108, the introduction of 'A Place to Grow' plan and threats to open Greenbelt lands for development. A regional planning body ideally protects regional interest from electoral aims and forms of populism. It is recommended that Greater Toronto or the Greater Golden Horseshoe promotes a regional body, similar to that of metro Toronto in the 1960s. Additionally, a more recent and relevant example could provide a more applicable structure. This is the regional planning practices of metro Vancouver. Metro Vancouver currently practices regional planning from a regional body. This body acts as a convener for local stakeholders and municipalities, both of which must help develop and agree to the implementation of regional strategies (White, 2007). The individual body has allowed for a smooth continuation of this planning practice throughout changing governments (White, 2007). This is not the only difference between the two plans. Metro Vancouver also has practiced a thorough process of implementation which involves the monitoring of local municipalities' progress of implementation. It's monitoring program has developed a set of 55 indicators which have the ability to track changes of growth in municipalities in terms of economic, environmental, and social factors (White, 2007). After three years after the plan has been put in action, municipalities use this guidance to provide a summary of how their local plans align with the regional intentions. This process provides an applicable practice of organization and implementation for the regional plan.

Therefore, the regional plan will be created and organized by a new regional planning body which is also governed by a regional council. The creation of this plan will be done in collaboration with local stakeholders and all of the municipalities incorporated into the plan. The creation of the plan must also involve developer roundtables intended to stimulate meaningful and realistic changes for the region considering future challenges ahead. After the creation of this plan, following the guiding supplementary studies, the regional plan will be placed in action. Municipalities are then responsible for drafting individual Official Plans to adapt to the vision. The Regional body and municipalities will then likely experience a series of drafts and draft approvals before the completion of Official Plan documents and Amendments. Following the approval of the Official Plans, zoning policies must be efficiently changed to reflect the regional plan. Similar to Metro Vancouver, municipalities will 'check-in' and work with the regional planning body to assess the changes to their planning structure. Following this process, further evaluation of growth performance and sustainability as a whole should be assessed on a regional scale.

Note: The explanation of this process is not intended to over-simplify the procedure of restructuring an already complex system. It is intended to show that, though complex, it is possible to change our planning system to create meaningful changes in the way we create places to live. The planning system in the GTA is comprised of a multitude of individual interests, but this is why a regional vision can be a solution to guiding the future of our metropolis.

Existing Structure of Planning in the Province and Region

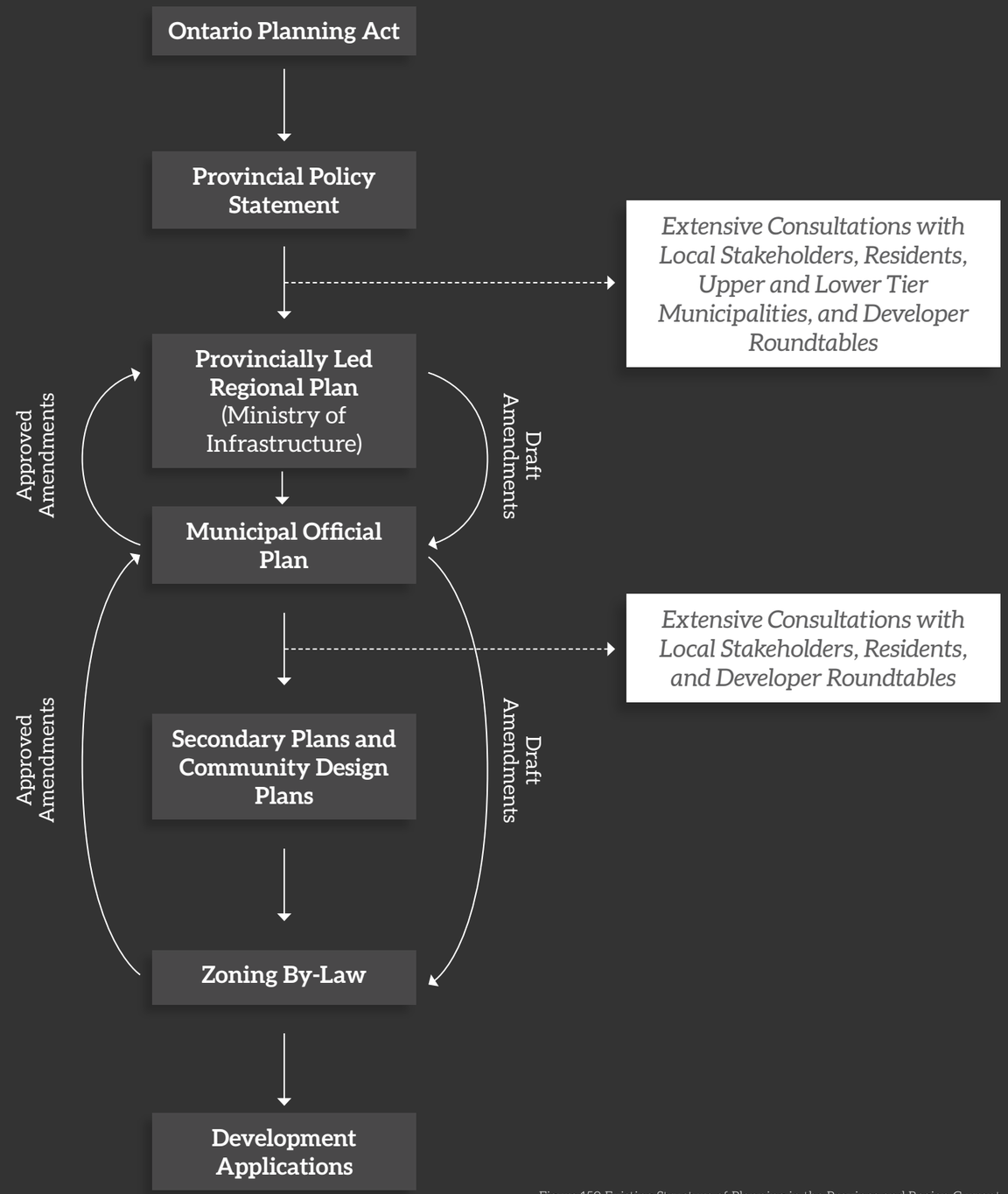


Figure 150 Existing Structure of Planning in the Province and Region Current Growth Condition

Existing Structure of Planning in the Province and Region

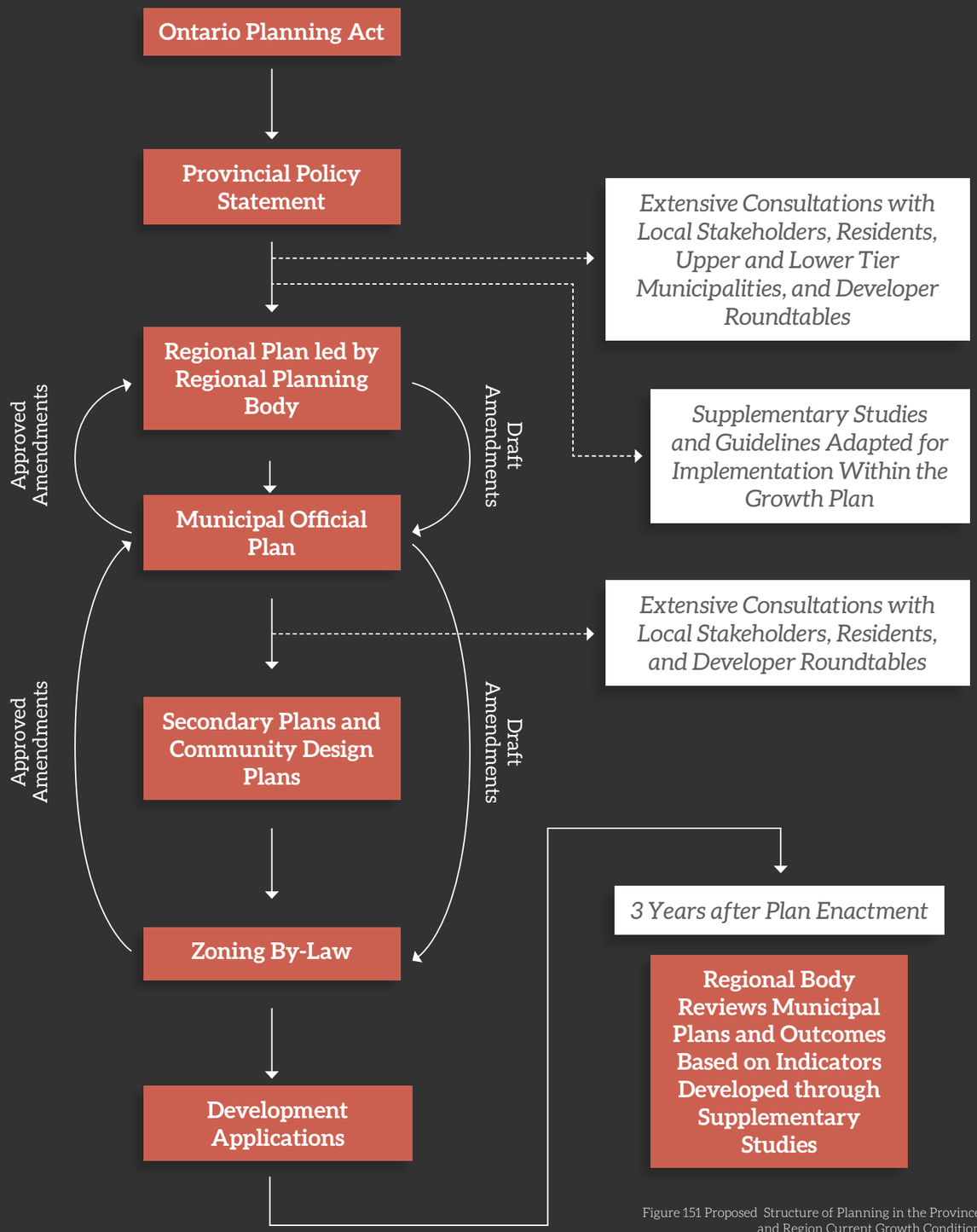


Figure 151 Proposed Structure of Planning in the Province and Region Current Growth Condition

Figure 152 1943 Regional Plan. The Growth Plan for the Greater Golden Horseshoe in Historical Perspective. Neptis

Suburban

16.0 Conclusions

The purpose of this research was to respond to the initial research question: How can a Regional Spatial Strategy bridge the gap between provincial policy and municipal allowances to plan sustainable suburban growth which will lower ecological footprint, increase biocapacity, and maintain a high quality of life in the Greater Toronto Region? In order to answer this question, the project took the necessary steps to address the following sub-questions, which are summarized below.

1. What research output or "plan" can best achieve these outcomes?
After reviewing the history of regional urban planning in the GTA and understanding the positive effects which it has had on the region within a small period of time, made returning to a regional planning body an attractive solution. The research also concluded that a large part of the issues involving implementation are due to a drastic difference of scales between the Province's Growth Plan and municipal planning bodies. This has created a large gap between urban theory/ policies set out by the Province of Ontario and the suburban development which is put into practice by municipalities and developers. Looking at this gap from a planning perspective offers an opportunity for a scale of regional design which provides a bridge between theory and practice.

Though it was clear that regional design and planning was the best way to tackle these issues, there was a multi-scalar element to the research project. The plans and scenarios focused on three development types within the region, and suggestions on how to improve their development standards. These multi-scalar solutions transition back into regional planning recommendations, but are a key part in developing an inclusive design vision for the entire GTA.

2. What are the general current challenges Toronto is facing including economic, social, and environmental issues?

While this is a wide-spreading question, the thesis thought to answer this sub-question through the lens of living quality. Beyond the focus of ecological footprint and biocapacity, there was a large focus on the connection between living quality and living affordability. This is due to the increasingly unaffordable nature of the region. This question was answered through discussions around high housing costs and the movement to suburban regions in attempt to access a higher quality living standard.

3. What policies have been proposed to tackle growth, sustainability, and resiliency? Where are they successful, and lacking?

The third sub-question refers to the literature review put forth in the policy analysis. Currently the are a handful of policies on the provincial and regional level which have attempted to tackle growth and sustainability. The most important of which is the Provincial Growth Plan. The Growth Plan was a fair attempt in creating more compact, dense development, in order to move towards a more sustainable city, but as the research points out, density does not always create sustainable development. The Growth Plan has created large swaths of densely built land, which still stay true to classic subdivision style design and an orientation towards automobiles and mono-functionality. These policies were successful in slowing down the expansion towards the Greenbelt which was significantly greater in the late 20th century, but more must be built onto the Growth Plan in order to go beyond density within future development. Additionally, the Greenbelt Plan, the Metrolinx Big Move Plan, and variations of the Growth Plan have been introduced to target these issues in the region.

4. Are the highest resource flows in the region (food, housing, mobility) influenced by spatial design in the peripheral regions?

The intent of creating these three indicators was to recognize whether these flows are affected by the current development style in the suburban regions. To answer this question the project established 15-year growth typologies and analyzed the performance indicators within each type of development. In most cases, the answer is 'yes'. But, the more complex answer is 'not always'. In many cases, the housing typology, street network, access to transit, and the nature of land use conversion directly link to these indicators, but there are intricate levels of consumption which cannot be understood at this level or even touched upon by the realm of urban planning. It is common that these more elusive indicators such as food consumption and electricity consumption can be influenced by income rather than by where people live. This research becomes one sided if one does not realize that where higher income residents live may have an effect on the data. High-income residents may live in larger houses, but also may consume more due to their income, not their housing type. Nonetheless, a large part of the performance indicators analysis found that there are many attributes within these flows which are affected by urban form and therefore there are solutions which can be made within future growth patterns to remediate them.

5. How can suburban development become more sustainable whilst sustaining a high quality of life?

This question was explored when relating the performance indicators to issues of livability. These issues intersect with livability through the issue of 'access' to these sustainable changes. This includes access to sustainable and local food production and distribution, access to all modes of transport, access to walkable communities, access to a range of energy transition options and affordable energy, and access to a resilient natural ecosystem (flood mitigation and recreation access). This question was also responded to through the question of affordability. Much of the time in the Canadian and global context, sustainable developments are intended for high-income residents creating a level of segregation and an inability for low-middle income residents to live more sustainably. The way to achieve affordable livability is to establish realistic development patterns and plan for mixed income and mixed ownership/rental units within developments, as well as offering a mix of unit types in the region.

6. What possible solutions can regional spatial design offer for the reduction of resource consumption and waste when accommodating growth?

These possible solutions have been addressed within the strategies section of the research report. Conclusions have not identified the 'best' solution but has identified several solutions within the design framework.

7. How did the regional spatial strategy use principles of sustainability and urban metabolism to develop a sustainable suburban growth process?

The spatial strategies and research project used principles of sustainability and urban metabolism to develop solutions for future growth in the GTA. The initial topic of sustainability was focused on questioning the assumptions made by the current Growth Plan. These assumptions were centred around density and compactness automatically creating sustainable results in practice. The entire intent of the research was to identify, what sustainability really means within the region and how to implement it through regional planning. Sustainability was implemented within the new regional spatial strategy by basing the proposal on quantifications and spatial explorations of the sustainability indicators in the GTA. In order to analyze these indicators, the research used urban metabolism studies including Ecological Footprint, Life Cycle Analysis, and identified the spatial relationships between their findings and the urban growth patterns.

This brings us back to the main research question: **How can a Regional Spatial Strategy re-bridge the gap between provincial policy and municipal allowances to plan sustainable suburban growth which will lower ecological footprint, increase biocapacity, and maintain a high quality of life in the Greater Toronto Region?**

The answer to this question resides in the very nature of the Greater Toronto Region. The morphological analysis of the GTA revealed that the region is a complex, surprisingly dense, polycentric city constructed of many different patterns and growth types. Similarly, future growth is occurring in the same manner. Urban growth is scattered across this large region, taking different forms, involving different actors, and drawing in different demographics of people. In order for a Regional Spatial Strategy to re-bridge the gap between provincial policy and municipal allowances, there must be a regional body which practices as a convener between the Provincial and Municipal level. This re-bridging should not stop here. Further consideration of scale must be implemented into regional planning for the region. The plan must create place-based solutions which considers different growth typologies to create more innovative requirements for the city, rather than a 'density anywhere' approach.

These solutions must be based on studies focused on sustainability and livability beyond just compactness and density. As explained within the recommendations, planning must do more to challenge the assumptions on sustainability. This can be done by integrating sustainability indicators and analysis in relation to ecological footprint and biocapacity, as practiced within this thesis.

Additionally, the Regional Plan must hold municipalities accountable, and work with planning staff to develop these concepts into their official plans, secondary plans and community design plans. These plans have the ability to affect sustainability all the way to the building scale.

As a last note, change in the region is often limited by development practices and ideas. The consideration of market development must be heavily weighed and considered throughout the regional planning process, but should no longer hinder the improvements to our built form in the GTA. The attitudes towards change must be shifted, as sustainability becomes a necessity in the coming years. The places in which people live and the security of the region in an uncertain future should not be seen as a 'growth machine'. The places we build are the places in which residents will reside for the next 100+ years.

Suburban

17.0 Reflections

In the beginnings of the Master's thesis, I was determined to explore the themes of urban planning and urban metabolism within the suburban context. The exploration of these themes expanded into the existing lack of theory within Canadian suburban development and the failure of policies to achieve sustainable growth within the region. There was a clear gap in research and theory on Canadian suburban development which takes a complex, systems-thinking approach to the expansion of peripheral regions. I intended to study the GTA through the lens of Urban metabolism to create a more progressive understanding of the region beyond traditional concepts of urban sprawl and the unequal balance of resource consumption. The intent was always to create solutions, but more importantly, create quantifiable evidence in order to understand the reality of our growth patterns and an urgency for change.

The next phase of the project was to explore whether many claims of 'unsustainability' and suburbia were true within Ontario and the GTA. To do this I had used Ecological Footprint and Biocapacity data. Of course, these datasets are quite broad and quite limited, but the amount of consistent data within these EF studies were the strongest research studies which could target broader issues in the Province and the Region. I then chose the 4 highest indicators within EF: food, mobility, goods, and housing. After careful consideration and research on the ability of urban planning to affect these issues, I had decided to consider only 3 indicators. The research would not include the subject of goods as it is incredibly difficult to track at a regional scale, and is mostly affected by income. The following section included a brief preliminary analysis on EF within these three indicators as well as the extent that biocapacity is being changed by suburban development.

When it came to preparing a methodology, I initially intended to develop the DPSIR approach into my research framework. While I did study the drivers, pressures the usefulness of the approach in this given project did not seem to be beneficial enough to continue. Continuing the analysis of the state, impact, and therefore responses were beginning to have obvious conclusions and became unnecessary for the research. Nonetheless, I continued with developing the indicators for sustainability within the suburban region. I expanded upon the 3 indicators within the ecological footprint, developed an Ecosystems Service approach for biocapacity and finally, introduced livability through design and policy analysis. Though the livability section in itself is lacking demographic analysis, the general conclusions consider the opportunity to reflect on this within place-based design.

The next step was to compare these indicators to the actual recent growth patterns which have taken place over the past 15 years. This established three growth types: Urban Intensification, Inner Ring Expansion, and Outer Ring expansion. The development of the growth types allowed the project to analyze the performance indicators in a more detailed and critical way.

Once conclusions had been drawn on past development, future growth, and the performance of these areas within my analysis, the research moved onto strategy development.

The strategies continued to focus on the growth typologies, as the spatial conditions and spatial opportunities in these areas differ so significantly. The strategies were developed based on the most obvious issues and opportunities within the analysis. Of course, more strategies could be (and should be) drawn on a building level scale within zoning policies, yet building performance and construction were out of the realm of this design framework.

The project then used 'What if' scenarios to explore design. This decision process was where there was the most difficulty in decision making. With the assistance of my mentors, the decision to use What if scenarios rather than a traditional strategy and vision was due to the complexity of the large region. Identify strict boundaries and solutions without identifying the realities of those decisions could easily invalidate my thesis research. What if scenarios provided the opportunity to criticize and optimize the strategies which I created for design with a more critical lens and to create more educated conclusions on regional design. These scenarios have allowed me to create conclusions on regional growth strategies for the region. Though the conclusions are rather broad, they are lessons which I have learned about the region of Toronto throughout my research process.

The last step in my research is implemented in this written section. The need to reflect on the process of my research project and the need to relate it to the broader societal and scientific context. It is possibly unnecessary to explain the shifts within planetary systems and vast global urbanization within this section, as this should be evident given the current global condition. In relation, the loss of land and resources and the dangers of climate change are well known and the need for sustainable design is far ranging. The intent of this thesis is to explore these issues of sustainability through the specific lens of the suburban system and expand on the limited theories of sustainability and suburbia within North American cities and to go beyond new urbanism.

The last thoughts within my reflection pertain to the ethical issues and limitations within my thesis. The largest and most obvious set back of my research is the lack of study of people and of demographics. Yet, this was also partly purposeful. Being from Greater Toronto has given me the prior understanding that the region has a wide spanning range of demographics. Knowing this complexity, I did not want to indicate large generalizations about certain populations. The intent was to focus on creating a livable and affordable area for all people. My intention was to avoid generalizations, but this also occurred of course within other sections of the thesis. This was bound to occur considering the scale of the study area and the available data, but critical consideration should be taken when furthering this research beyond this thesis. Lastly, other than government actors and developers, actors and stakeholders were not specifically identified within my scenarios. This is because many of the actors and stakeholders were consistently land owners, residents, municipalities, community groups and regional bodies. These stakeholders are already linked to the current planning process within the GTA and in turn, including an analysis would only lead to similar solutions and structures which are already practiced in the region and the planning structure.

Finally, the 2019 version of the Growth Plan has been introduced in June during the creation of my thesis. Comments on this and Bill 108 were loosely touched upon throughout the thesis, but given that this plan has yet to be implemented or prove its significance, the report does not provide an analysis.

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The Density and Sustainability Paradigm:
Densification for Sustainable Suburbia?

Michelle Blom
4749073

Abstract
Densification has been a critical part of the movement towards ‘new’ or ‘post-’ suburbanization. Densification has been a particular instrument which has been used to identify and classify changes within the suburban landscape. While the shift towards densifying these settlements has multiple contributors, urban planning trends which promote ‘compactness’ and ‘intensification’ have considerably affected such change. These trends have been dominating the contemporary planning discourse with the main objective of combatting suburban sprawl, which has been widely accepted as a large contributor to climate change and ‘unsustainable’ living. The consistent relationship between sprawl and climate change within contemporary planning discussion has contributed to one common assumption: that density equals sustainability. The following paper will question this assumption by discussing ‘compaction’ movements which support this claim, such as Smart Cities, New Urbanism, and Sustainable Development. This paper has reviewed the critiques on the theories and practices of implementing sustainability through intensification. Through this review it has become evident that achieving sustainability becomes far more complex than promoting density. However, the relationship between density and sustainability will most likely continue to be used as a tool on various sides of growth and no-growth coalitions. It becomes clear that density alone can tell us little about sustainability factors, such as transportation, energy consumption, and building morphology and has yet to provide more insights into what creates a sustainable neighbourhood.

Keywords: Density, Intensification, Compact Cities, Sustainability, Suburban, Post-suburban, New Urbanism, Smart Growth, Liveability

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Introduction
It is evident that suburbs have been changing. Internationally, many suburban areas have gone through a significant evolution from the process of dispersal to densification, increasing the complexity and diversity of different regions (Charmes & Keil, 2015). Such settlements, which have fallen under various terms such as, ‘ex-urbs’ (Soja, 2000), edge cities’ (Fishman, 1987), and ‘technoburbs’ (Lang, 2003), have been signals of new suburban morphologies. Many of which have been classified within the umbrella of ‘post-suburban’ (Phelps & Wood, 2010). Such forms of settlements have changed the traditional geographical features of concentric cities and moved towards more polycentric, fragmented urbanisms, blurring the lines between urban and suburban regions (Charmes & Keil, 2015).

The intent of this paper is not to debate between the post-suburban or new suburban landscape, but to address issues related to their frequent commonality: density (Phelps & Wood, 2010). The urbanization of suburbs have been a result of multiple factors including urban politics, land uses, patterns of ownership, and various forms of ownership capital, but density remains a common trait of the changing suburban region (Charmes & Keil, 2015). But why density?

The allowance and promotion of density has become an unquestioned necessity for suburban regions over the past decades. This has stemmed from international urban planning trends which promote ‘compactness’ or ‘intensification’ within new development. These trends have been able to dominate the contemporary planning discourse, with the main objective of combatting suburban sprawl. Sprawl has already been widely accused of causing high consumption of resources and land, dependence on automobiles, poor urban health, poor social integration, and overall, a large contributor to climate change and environmental devastation. These ‘facts’ have become widely sanctioned and often unchallenged within the planning discourse (Grosvenor & O'Neill, 2014). This has instigated the start of planning movements which set out to eliminate the issue of dispersal. There is a wealth of propositions amongst ‘compaction’ coalitions such as, New Urbanism, Smart Growth, Compact Cities and Sustainable Development, which call for the increase of densities in cities to decrease sprawl and make them more sustainable and resilient (Charmes & Keil, 2015). The fact that these movements were set out to avoid sprawl, and that sprawl was an enemy to our environmental well-being, crafted a rhetoric where density (any density) is necessary in order to create sustainable cities. The assumption is still relevant today, where sustainability via density is often used for political leverage for development in urban areas (Charmes & Keil, 2015). It has become clear that this focus on density is a problematic and questionable proxy for representing urban structure (Grosvenor & O'Neill, 2014). This paper is intended to question this idea by firstly discussing movements of compactness which have historically held this claim, their criticisms through the lens of the livability and sustainability prism, and their results in studies on sustainability indicators in real world examples.

Density: Quantity Without Quality?
In order to review whether promoting density has resulted in sustainable form, we must define the way urban theories utilize density. The calculation of density is a key concept which is deployed for extensive urban research (Pafka, 2013). It is often at the core of theories concerning urban form, human well-being, and environmental sustainability (Pafka, 2013). These calculations were popularized in the early 20th century, most notably through English town planner Raymond Unwin. Unwin used limiting density as the simplest way to avoid overcrowding of buildings and people, considering it a more accurate method than measuring the cubic metres of built structure on a portion of land (Pafka, 2013). Such practices persisted among many urban writers within various visions and schemes and continue to be used in practice today (Pafka, 2013). The measurements of urban density are often used to calculate a number of factors such as people, ground/gross floor area, and built volume, in relation to a reference area which can be located on

multiple scales from the plot to the region (Pafka, 2013). In this paper, we discuss density with the consideration of residential units or residents per unit of land, rather than multi-functional density such as jobs per unit of land.

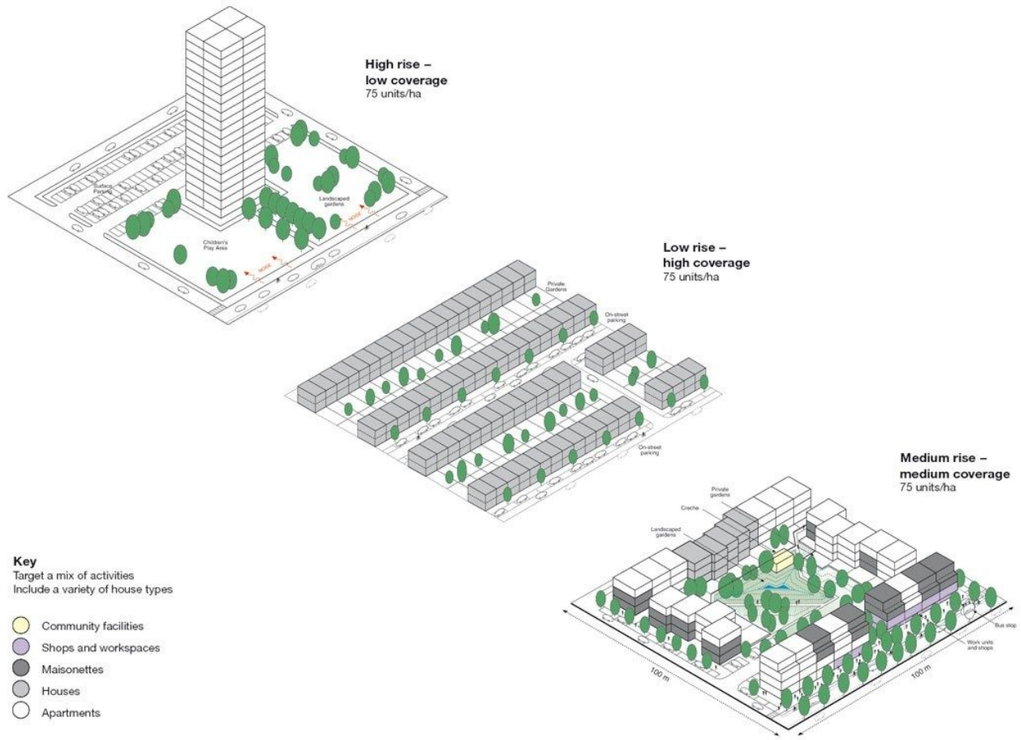

Figure 1: Richard Rogers, Urban Task Force, Towards and Urban Renaissance, 1999

While density calculations are still widely used to represent urban areas, they have often been criticized for misrepresenting urban form and morphology (Grosvenor & O'Neill, 2014). In reality, a single density measurement can generate a variety of different built form types. For example, it is possible that the same number of people can be housed in a three storey apartment, as can be housed in a four to nine-storey apartment depending on the urban block size, and floor space area. This can be seen within Figure 1, where low-rise, mid-rise, and high-rise typologies on the same plot can all result in realistic examples of 75 residential units per hectare. This happens partly because such quantifications of people ignore the variations within aggregated areas and do not reflect the building form, transport service, community linkages and other accessibility factors (Grosvenor & O'Neill, 2014). The inadequacies within such calculations relate directly to the principles which lie within sustainable neighbourhood design. By assuming that density results in sustainability, we ignore that density does not always result in sustainable transport, lowered energy consumption, social equity and increased ecological quality. The inadequacy of density as an indicator for sustainable quality raises the question of whether density can actually achieve sustainability. If there are connections between sustainability and density, the content lacks empirical evidence and has been portrayed in a fairly general and over-simplified manner (Grosvenor & O'Neill, 2014). Nonetheless, urban theories continue to promote increasing the density of particularly suburban areas in order to create a more sustainable environment.

The Promotion of 'Compaction'

As previously stated, many popularized theories from the late 20th century continue to be embedded within the current planning discourse as proponents of 'compactness'. Compaction is intended to increase the density of urban areas in order to reduce the use of vehicles for everyday travel, and to increase social diversity and urban vitality (Campbell, 1996). Such theories were known to surface after the emergence of sustainable development in planning in the 1980s (Grant, 2009). The core of this vision stemmed from the idea that fuel consumption was lowered as densities increased, as first proposed by Newman and Kenworthy (1989) (Campbell, 1996). In the United Kingdom, compaction is still often promoted as the best option for lowering carbon emissions (Campbell, 1996). Within North America, compaction takes form within New Urbanism and Smart Growth policies which also focus on higher densities and improvements in public transport. These theories are some of the major movements promoting increased suburban density, but of course, the discourse around density and sustainability has not been limited to these. The following is an explanation of these theories as a rise of the movement towards compaction.

Sustainable development, a seemingly immense theory has found its way into many policies across the globe in the 1980s. The interest in this practice began to influence planning approaches in North America and Europe after the publication of the Brundtland Commission report (Grant, 2009). "Though theorists presented differing interpretations of sustainability (e.g.,Rees, 1990; Van der Ryn & Calthorpe, 1986), in planning documents and discourse sustainability rapidly became a mantra" (Grant, p. 3, 2009). Generally, the discussion centred around creating compact form, increasing sustainable transport options, creating healthy living environments, affordable housing, and creating environmental responsibility (Grant, 2009). Such vast practices and concepts merged with other theories and policies in the 1990s, eventually fusing with the ideas of Smart Growth and New Urbanism in North America and compaction in the United Kingdom (Grant, 2009). The idea that compaction and density began with the emergence of Sustainable Development begin to make clear the connection between sustainability and density. The connection between compactness and sustainability has fused together with the densification of neighbourhoods for environmental protection.

The concept of *Smart Growth* began to emerge in the 1990s in American planning circles and gained a strong momentum in U.S. states (Eidelman, 2010). Its origins stemmed from a series of documents

developed by the American Planning Association and the Natural Resources Defense Council (Ewing & Meakins & Bjarnson, Grace & Hilton, 2011). The term "smart growth" originally was a response to the "no growth" slogan from environmentalists who were protesting urban expansion, especially suburban growth. The solution was to preserve open and natural areas, redevelop and densify in core areas, and promote mixed land uses and town centres in less urban areas (Ewing, et al., 2011). The principles of Smart Growth were intended as the name infers to - control suburbia which threatened to grow into natural, agricultural and open space.

New Urbanism is another 'recent' development in planning which became popularized in North America for the development/redevelopment of suburban neighbourhoods. It is closely related to Traditional Neighbourhood Design and Smart Growth with a different focus point. New Urbanism uses design principles which were common before automobiles dominated urban form (Ewing, et al., 2011). At its core, it promotes sustainable transport, increased density, better connectivity, and enhancing the central core of neighbourhoods (Ewing, et al., 2011). Though similar to smart growth, New Urbanism is framed through an aesthetic approach, often implementing its principles through form-based code and increasing the vibrancy of neighbourhood centres (Moos, 2018). Its precursors include the development of seaside Florida and drew proponents substantially related to the works of Jane Jacobs and was pioneered by Duany and Plater-Zybrek (Grant, 2009). By 1993 these ideas merged at the Congress for the New Urbanism.

Measuring the Sustainability of Compaction Theories and Defining Conflicts

In order to review the validity of these theories as a successful method in achieving (theoretical) sustainability with density, we first must define sustainability and its theoretical conflicts. Currently, the United Nation's sustainable development goals are commonly used as a marker for a global vision for sustainable development. Yet, the 17 core values of these indicators can still be reduced to the traditional, three "E"s of sustainability including the environment, the economy, and equity for improved simplicity (Godschalk, 2004). These three 'pillars' of sustainability, while theoretically adequate, have presented conflicts when put into practice (Godschalk, 2004). Campbell (1996) has tried to illustrate these contradictions of sustainability as shown in figure 2.

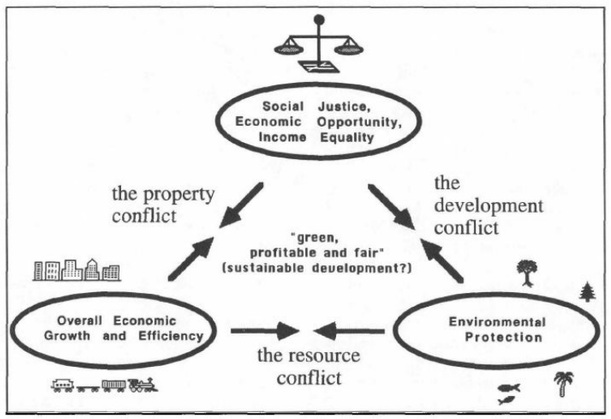

Figure 2: The triangle of conflicting goals for planning and the three associated conflicts. Scott Campbell. ()

Campbell establishes these conflicts as the 'planner's triangle', which reveals the historic tendency of planners to promote sustainable development, but experience a conflict between the pillars of sustainability. Campbell establishes the 'property conflict', between Equity and Economy as being a result of competing claims for privatized properties, which can result in gentrification and social segregation (1996). On the other hand, if the land is used for Equity or 'social purposes', such as social housing or public facilities, it requires public intervention which conflicts private interests and public goods (Campbell, 1996). The 'resource conflict', set between Economic and Environmental interests, is bound by the nature of business which resists the regulation of exploiting natural resources, but also needs those resources to be conserved so that business may be account for future demands (Campbell, 1996). Lastly, there is the 'development conflict', which belongs to the Environmental and Equity axis. The conflict between these two pillars stems from the challenge of increasing social equity, while also protecting the environment simultaneously (Campbell, 1996). It is often difficult for marginalized populations to find greater economic opportunities if environmental protection diminishes economic growth (Campbell, 1996). While these concepts remain a simplified theoretical explanation of conflicts with sustainability, it offers a method to review sustainable development practice within urban theory. To build upon this concept, Goschalk states that the three pillars of sustainability are missing an aspect of 'livability' which is espoused by a number of advocates in urban theory (2004).

> "Livability operates at the level of the everyday physical environment and focuses on placemaking (Bohl, 2002). Within the livability arena are both the two-dimensional conceptual aspects emphasized by sustainable development (economy, ecology, and equity) and the three dimensional aspects of public space, movement systems, and building design. In other words, the livability vision expands the sustainability mix to include land use design aspects, ranging down to the micro scale of the block, street, and building, as well as up to the macro scale of the city, metropolis, and region." (Goschalk, p.6, 2004)

Goschalk's iteration of the sustainability conflict triangle offers a method to include livability, often used within theories advocating for density, such as New Urbanism and Smart Growth. Figure 3 reveals the Goschalk diagram as a prism rather than a triangle, assessing the conflicts through the lens of livability within sustainability.

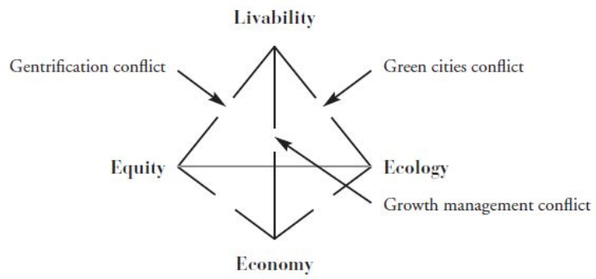

Figure 3: The sustainability/livability prism: Value conflict and gaps Goschalk, 2004

The prism adds three additional conflicts and tensions between livability and sustainability. The 'growth management conflict' rises from competing ideas that

unmanaged developments, such as practices of dispersal, either provide high-quality living environments or will always hinder the development of social equity in projects (Goschalk, 2004). Tensions between livability and ecology are part of the 'green cities conflict', which involves arguments around whether cities are capable of incorporating ecological sustainability at all, as opposed to limiting city development and preserving the existing natural environment (Campbell, 1996). Lastly, the livability and equity axis exposes a 'gentrification conflict' stemming from competing beliefs on whether poorer neighbourhoods should be preserved or redeveloped and improved to attract middle and upper- class populations (Goschalk, 2004).

The sustainability/livability prism creates a better framework to analyze the complexity of achieving sustainable development through densification and intensification theories. As New Urbanism, Smart Growth, and Sustainable Development all inherently support creating livable as well as sustainable communities through different methods. None of these theories have been capable of resolving all six conflicts, nor have they attempted to achieve all four goals of sustainability/liveability (Goschalk, 2004). All three approaches oppose sprawl as a common enemy, but have different planning strategies to manage it and fall within different sections of the sustainability prism.

As previously stated, Sustainable Development is centred around creating sustainable transport, healthy living environments, affordable housing and increasing environmental responsibility (Grant, 2009). Common critiques of the planning vision are the unrealistic necessities for ecological responsibility and economic development, which create issues between resource consumption and preservation. While Sustainable Development calls for compaction, theoretically it has been unsuccessful in achieving sustainability.

Smart Growth promotes density through advocating for changing the management of growth legislation which will preserve land through infrastructure provision and land development regulations (Ewing, et al., 2011). Goschalk identifies two conflicts within Smart Growth, 'growth management' and the 'green cities' conflict. Similar to New Urbanism, Smart Growth has been limited by 'growth management' by attempting to limit private management of land and inhibiting the expansion of cities. It also falls within the 'green cities' conflict by trying to limit expansion, under the assumption that expanded cities cannot be more ecologically sustainable than surrounding areas.

New Urbanism, similar to Smart growth, advocates having attractive and livable spaces for daily life as a key tool to combat sprawl. These values align themselves in the form of 'compactness; and public spaces through traditionally designed neighbourhoods and corridors. New Urbanism falls under the assumption that the housing market will shape itself to account for its offerings in livability (Trudeau, 2018). This attempts to address the Growth Management conflict under the belief that growth should be managed, balancing livability and economic value. New Urbanism has often been criticised for this standpoint- based on societal assumptions of controlling a private market by offering livable communities, ignoring the reality of real estate development (Ewing, et al., 2011).

Density and Sustainability in Practice

The livability prism offers insights into why, theoretically, these planning visions have been conflicted in achieving sustainability. However, it does not provide evidence of sustainable or unsustainable results when implementing compaction and density. Fortunately, the densely populated discussion around compaction and sustainability has instigated a range of studies which explore the sustainability of compact versus dispersed development. There are three general commentaries suggesting that density has yet to prove it is sustainable: 1.) The inaccuracy of previous studies on density and sustainability 2.) the results of more recent studies with more detailed indicators 3.) the political benefits from promoting density outweighing the realities of sustainable development.

The key discussion within the field primarily focuses on the claim that dense areas have lower vehicular transport use. Within past studies, researchers have claimed that residents in denser areas travel less using automobiles and therefore, have lower carbon emissions from fuel consumption (Charmes & Keil, 2015). The lowered automobile use within dense areas is largely factual, however these studies neglect other modes of travel within their analysis. In their assessment of energy consumption in transportation, the pioneers of the discussion, Newman and Kenworthy (1999), as well as other studies, have not taken long-distance trips (business or pleasure) into account (Charmes & Keil, 2015). In a study for the Greater Oslo Region, challenging the compact city as a sustainable urban form, Holden & Norland found that the highest levels of leisure-time traveled by plane and car were represented within urban areas with higher densities (2005). These results show that denser areas may use less fuel daily, but a high amount overall.

Lowered transportation is not the only unanswered claim. The assumption that high density buildings require less energy has also been scrutinized within research. Again, the fact that apartment buildings on average have generally lower energy consumption than houses, does not necessarily mean they are sustainable (Charmes & Keil, 2015). According to Charmes, pre-existing detached houses are often much more adaptable than high-rise buildings and it is easier to reduce energy consumption with renewable energy installations in these areas (Charmes & Keil, 2015). Within the Greater Oslo Region study, researchers also found that energy use in decentralised concentration could lead to even lower energy use in households and that the difference between housing density and energy use is less significant in buildings constructed after 1980 (Holden & Norland, 2005). This means, going forward, that the energy consumption of newly constructed buildings will not have the same discrepancies between high and low-density.

If the disconnect between density and sustainability in real world situations is so large, then why promote density at all? It is not a leap to conclude that achieving sustainability has not been the main objective of promoting density. Some

indicate that the call for density with the intent of sustainable development has been used politically, to hinder anti-growth coalitions and push development (Charmes & Keil, 2015).

> "Indeed, the density turn within environmental discourse is especially convenient for promoting projects of growth coalitions or (more fundamentally) urban growth, and often serves to override local resistance. In many suburbs, residents expect that their representatives seek to protect the environment, preserve quality of life and limit growth, rather than attract new jobs or homes." (Charmes) p 589

Density in the name of the environment has the ability to discredit NIMBYisms and slow local challenges against development. It seems that if one is against growth, one is against the planet. This continuous use of density as a means for any urban growth has created a justification for growth coalitions and limited the discussion on sustainable suburbs.

Conclusions

It is clear that the *direct* relationship between sustainability and density has been moderately discredited through recent research. In order to maintain a proper discussion around the sustainable future of suburban or post-suburban areas, planners must first develop a realistic discourse around them. Discussion must move beyond a 'density first' approach and analyse several factors of sustainability and livability to better understand actions to be taken with future growth. This is not to say that the 'compactness' which has been attempted through Sustainable Development, New Urbanism, and Smart Cities visions is entirely irrelevant, but combinations of values and the resolution of sustainability conflicts could eventually create sustainability within planning practices.

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